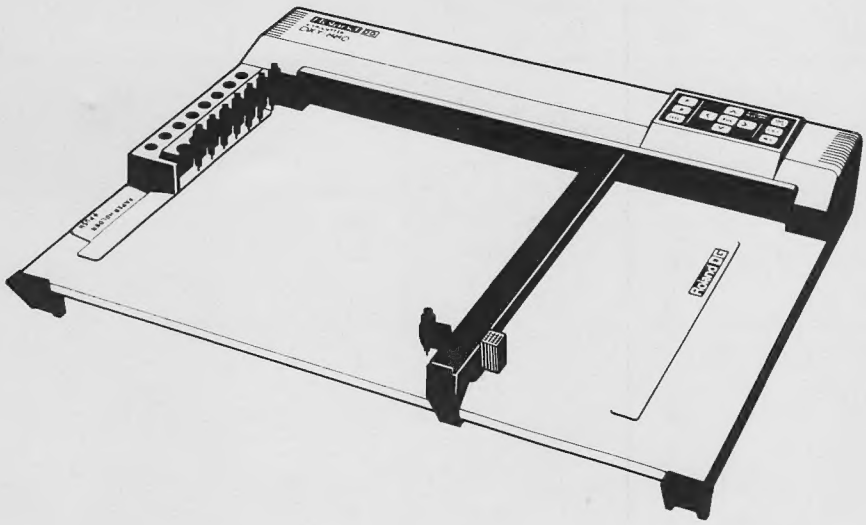
Operation Manual



ROLAND DG
X-Y Plotter

DXY-880

Congratulations on your purchase of the ROLAND DG X-Y Plotter [DXY-880].
Read and understand this manual well before using the DXY-880.

ROLAND DG CORPORATION

Warning

This equipment has been certified to comply with the limits for a Class B computing device, pursuant to Subpart J of Part 15 of FCC Rules. Only Computers certified to comply with the Class B limits may be attached to this equipment. Operation with non-certified computing device is likely to result in interference to radio and TV reception.

Radio and Television Interference

The equipment described in this manual generates and uses radio-frequency energy. If it is not installed and used properly, that is, in strict accordance with our instructions, it may cause interference with radio and television reception.

This equipment has been tested and complies with the limits for a Class B computing device in accordance with the specifications in Subpart J, Part 15, of FCC rules. These rules are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that the interference will not occur in a particular installation, especially if you use a "rabbit ear" television antenna. (A "rabbit ear" antenna is the telescoping-rod type usually contained on TV receivers.)

You can determine whether your computer is causing interference by turning it off. If the interference stops, it was probably caused by the computer or its peripheral devices. To further isolate the problem:

- Disconnect the peripheral devices and their input/output cables one at a time. If the interference stops, it is caused by either the peripheral device or its I/O cable. These devices usually require shielded I/O cables. For Roland DG peripheral devices, you can obtain the proper shielded cable from your dealer.

If your computer or its peripheral devices does cause interference to radio or television reception, you can try to correct the interference by using one or more of the following measures:

- Turn the TV or radio antenna until the interference stops.
- Move the computer or its peripheral devices to one side or the other of the TV or radio.
- Move the computer or its peripheral devices farther away from the TV or radio.
- Plug the computer or its peripheral devices into an outlet that is on a different circuit than the TV or radio. (That is, make certain the computer or its peripheral devices and the radio or television set are on circuits controlled by different circuit breakers or fuses.)
- Consider installing a rooftop television antenna with coaxial cable lead-in between the antenna and TV.

If necessary, you should consult your dealer or an experienced radio/television technician for additional suggestions. You may find helpful the following booklet, prepared by the Federal Communications Commission.:

"How to Identify and Resolve Radio-TV Interference Problems"

This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, stock number 004-000-00345-4.

Congratulations on your purchase of the ROLAND DG X-Y Plotter [DXY-880].
Read and understand this manual well before using the DXY-880.

TO THE USER

- Do not place objects on the plotter and power cord as this may result in accidents or fires.
- Ensure that the power supply is within ± 10% of the rated voltage.
- Locate the plotter in an area with good ventilation and as free as possible from dust and humidity.
- Ensure that the plotter is not subjected to heavy shocks.
- If the panel becomes dirty wipe it with a cloth dampened with water or neutral detergent. Do not use thinner or alcohol under any circumstances.

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INTRODUCTION

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1. Outline and features

The DXY-880 is a compact 8-pen X-Y plotter with full capabilities and high cost performance.
Simple commands sent from the computer enable the drawing of characters and graphic patterns, etc. The plotter supports a digitizing function for use in sending information on its current status, etc., to the computer, and may be used as a powerful tools in business, art, and drawing.
The DXY-880 supports the following features as well.

(1) Two types of command system are supported as standard.
Plotter commands consist of one or two characters and are easily used with BASIC.

- DXY commands

These commands do not require complicated procedures. They are independent simple commands permitting high level drawing, and are completely compatible with softwares for DXY-800 while expanding the functions of each command.
The RD-GL commands may be called and used with these DXY commands.

- RD-GL (ROLAND DG GRAPHIC LANGUAGE)

A systematically configured group of powerful commands may be used freely for drawing control in the setting of accurate drawing conditions, scaling, window, and user coordinates.
The computer is informed of the current status of the DXY-880 by means of the digitizing function.

(2) High resolution (0.05 mm steps)
The pen moves in minimum steps of 0.05 mm to ensure high levels of accuracy in drawing. As coordinates may be set in 0.1 mm steps with the DXY commands, coordinate specifications and calculations within programs are a comparatively simple matter.

(3) Both Parallel and Serial interfaces are included as standard.
Both a parallel interface (centronics) and a serial interface (RS-232C) are included as standard.

(4) High speed drawing at 200 mm/sec.
As drawing speed remains constant despite changes in direction of drawing, the total drawing time required is reduced considerably. The drawing speed may be specified with a command to suit the type of paper and pen in use.

(5) Improved ease of use
The built-in stand enables the use of the DXY-880 in a semi-vertical position, and the clip-type paper holder and the special pen stocks (to prevent drying of the pens) ensure simple and trouble-free use of the plotter.

(6) Scale and window functions
Scale of a drawing is possible in a number of variations. As well as drawing only a part of a graphic pattern, this part may be enlarged and reduced, and by use of the panel switch, may be drawn in miniature at the desired position on the paper.

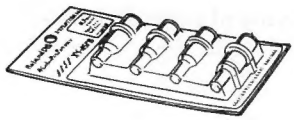
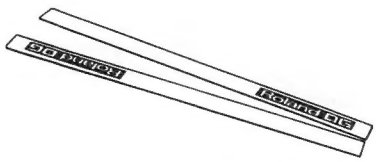
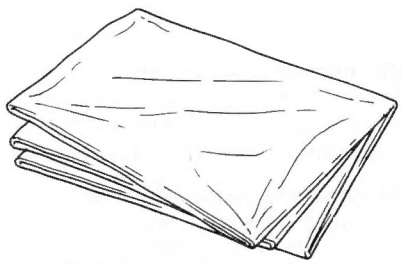
(7) Characters may be slanted and rotated
Characters may be slanted and lines of characters drawn at various angles, and drawing position and character width and height may be specified in detail with commands.

(8) Built-in data buffer
The DXY-880 includes a 3K bytes data buffer which may be expanded to 10K bytes if required (option).

(9) Various character fonts included as standard
Various character fonts (English, German, French, Spanish and Scandinavian, etc.) may be selected with the DIP switch on the rear panel or with the use of commands.

2. Checking contents of box

The following accessories are also included in the shipping carton of DXY-880. Check before use to ensure that they are included.

Accessory	Quantity
1) Original pens 0.3 mm water based fiber tipped pen XY-4SPB-WN (black, blue, red, green) . . . . . 1 XY-4SPC-WN (orange, purple, brown, pink) . . . . . 1 	8
2) Magnetic strip paper holders 	2
3) Marking seal (CROPMARKS SHEET)	1
4) Pen holders XY-4PH (4 per set) 1 	4
5) Original AC adaptor	1
6) Dust cover 	1
7) Manual	1

OPTIONS

The following are available for the DXY-880 as option.

Pen holder set XY-4PH 4 per set

Original pen sets

Water based fiber tipped pens

XY-4SPA-WN	0.3 mm dia.	(black) 4 per set
XY-4SPB-WN	0.3 mm dia.	(one each of black, blue, red, green) 4 per set
XY-4SPC-WN	0.3 mm dia.	(one each of orange, purple, brown, pink) 4 per set
XY-4SPA-WW	0.6 mm dia.	(black) 4 per set
XY-4SPB-WW	0.6 mm dia.	(one each of black, blue, red, green) 4 per set
XY-4SPC-WW	0.6 mm dia.	(one each of orange, purple, brown, pink) 4 per set

Oil based fiber tipped pens for OHP film

XY-4SPB-ON	0.3 mm dia.	(one each of black, blue, red, green) 4 per set
XY-4SPC-ON	0.3 mm dia.	(one each of orange, purple, brown, yellow) 4 per set
XY-4SPB-OW	0.6 mm dia.	(one each of black, blue, red, green) 4 per set
XY-4SPC-OW	0.6 mm dia.	(one each of orange, purple, brown, yellow) 4 per set

Water based ballpoint pens

XY-4SPB-BP (one each of black, blue, red, green) 4 per set

Overhead transparency kit

XY-TRK 50 transparent sheets
OHP pens
0.3 mm 8-color set
0.6 mm 8-color set

Connecting cables

For parallel interface (Centronics)

XY-IPC IBM PC(5150), PC XT(5160)

For serial interface (RS-232C)

XY-PS-11 APPLE II, IIe
XY-PS-13 IBM PC(5150), PC XT(5160)

Parallel interface card

XY-APL APPLEII,IIe (cable included)

* APPLEII, IIe are trademark of Apple computer inc.
* IBM PC, PC XT are trademark of International Business Machine Corporation.

3. Precautions

(1) Installation

- Place the unit on a flat table or install vertically (60°) using the built-in stand.
- Avoid locations where the unit will be exposed to direct sunlight, high temperatures, and dust or humidity.
- Avoid locations where the unit will be exposed to high levels of vibration or electrical noise.
- As the power supply (AC adaptor) generates heat during operation, use only in a well ventilated area to ensure good cooling.

(2) Use

- Ensure that the power supply cord and computer input/output cables are installed in such a manner as to prevent accidents or disconnection while in use.
- On first connecting the DXY-880 to the computer be sure to perform a self operation check (see p.2-11) to check that the plotter is operating normally.
- Set the pen carriage to the lower left prior to turning power ON. If it is not set in this position the maximum effective plotting area will not be obtained and pen exchange will be impossible.
- Do not block the ventilation openings of the plotter or place objects on the AC adaptor.

(3) After using, or when not using the plotter

- Remove the pens from the pen grips and pen carriage after use.
- When not using the pens, replace the caps or place them in the pen stocks to prevent the ink evaporating.
- When not using the plotter, always remove the power plug from the outlet.

(4) Miscellaneous

- Never lubricate any of the mechanical parts.
- Never place heavy objects on the drawing board or allow it to become scratched.
- Do not apply heavy loads to the arm or carriage, and avoid impacts.
- If the drawing board or X-rail cover are dirty, clean gently with a cloth dampened with neutral detergent.

- Do not move the arm or carriage manually after turning power ON.

2

PREPARATIONS

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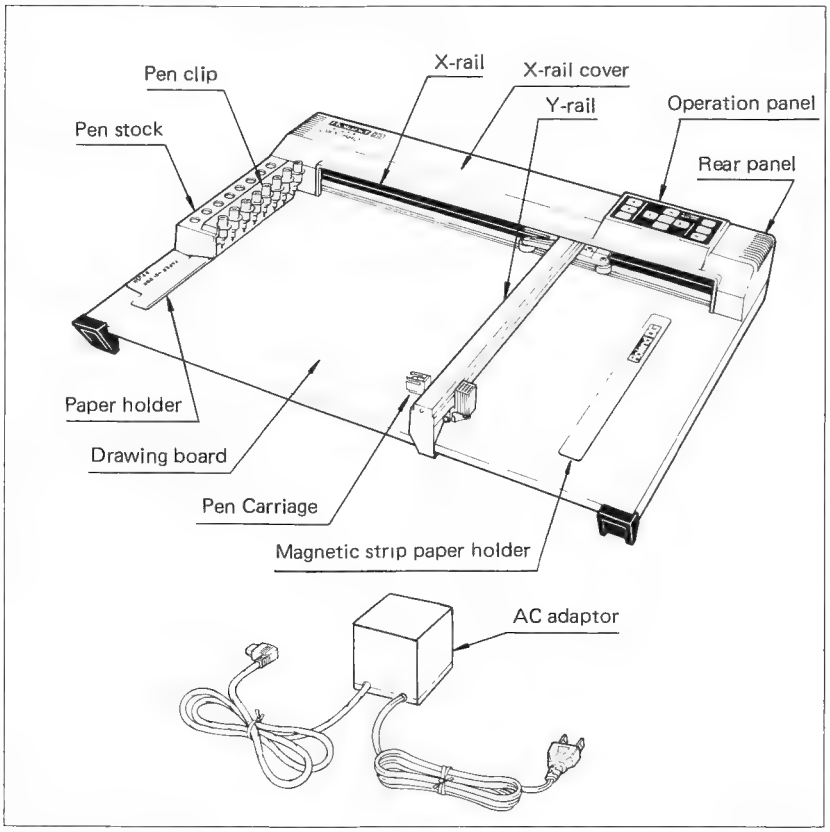
1. Components

This section explains the correct use of the DXY-880 in sequence. Check each step in order.

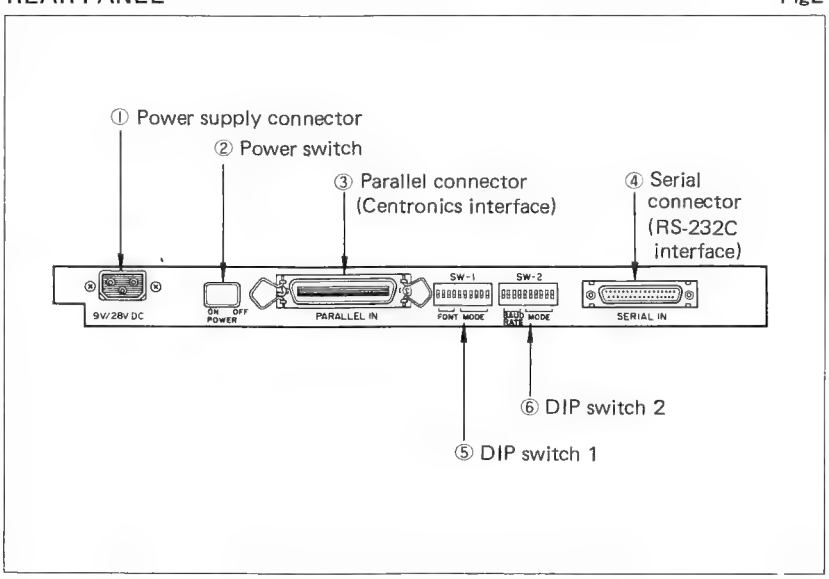
EXTERNAL VIEW

Fig I



REAR PANEL

Fig2



① **Power supply connector**
Connect the AC adaptor.

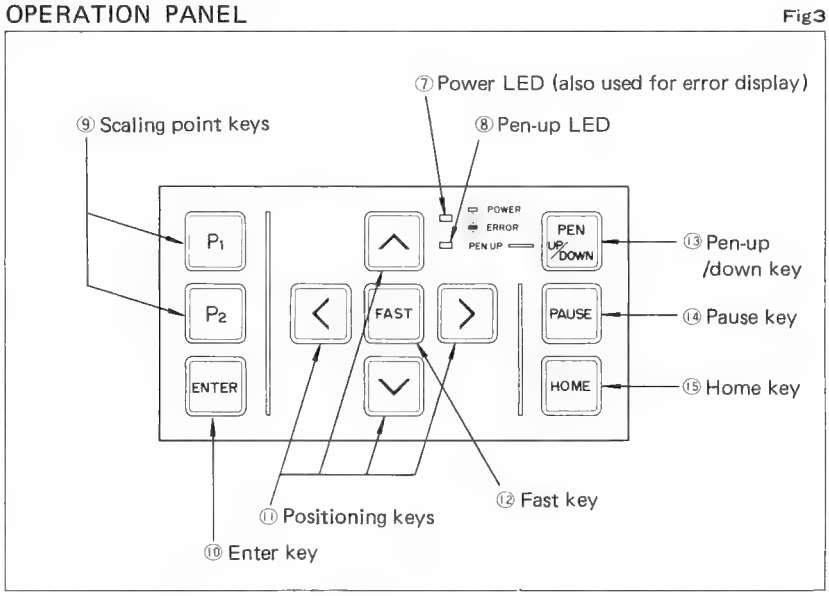
② **Power switch**
Power is supplied to the DXY-880 when this switch in ON (▬) and the power LED ⑦ is lit.

③ ④ **I/O connectors**
These connectors are used to connect the DXY-880 with the computer. Either the Parallel (Centronics) or serial (RS-232C) interface connector may be used depending upon data specifications.
Note: Both connectors cannot be used simultaneously.

⑤ **SW-1 (DIP switch 1)**
Use to select the I/O connector (parallel or serial), set paper size, character font, and control commands(DXY mode or RD-GL mode).See the Appendix (p.8-13) for details of the DIP switch.

⑥ **SW-2 (DIP switch 2)**
Use to set the data format and baud rate when the serial interface is used. See the Appendix (p.8-13) for details of the DIP switch.

OPERATION PANEL Fig3



⑦ **Power LED**
This LED is lit when power is ON and blinks when an error occurs.

⑧ **Pen-up LED**
This LED is lit when the pen-up/down key is pressed to raise the pen.

⑨ **Scaling point keys (P1, P2)**
When the P1 or P2 keys are pressed, the pen is raised and moved to the scaling point P1 or P2. When the scaling points are set manually these keys are used in conjunction with the Enter key. See p.3-18 "Reducing graphic patterns, manual setting (from the operation panel)" for details.

⑩ **Enter key**
The scaling point is set by pressing the enter and P1 or P2 key. This key is also used to digitize points on the drawing board. For details, see p.3-18"Reducing graphic patterns, manual setting (from the operation panel)", and the sections on digitizing.

⑪ **Positioning keys** △、▽、◁、▷
These keys are used to move the pen manually in any of the four directions indicated on the keys. Pressing two keys simultaneously will result in the pen moving diagonally across the drawing board in the relative direction.

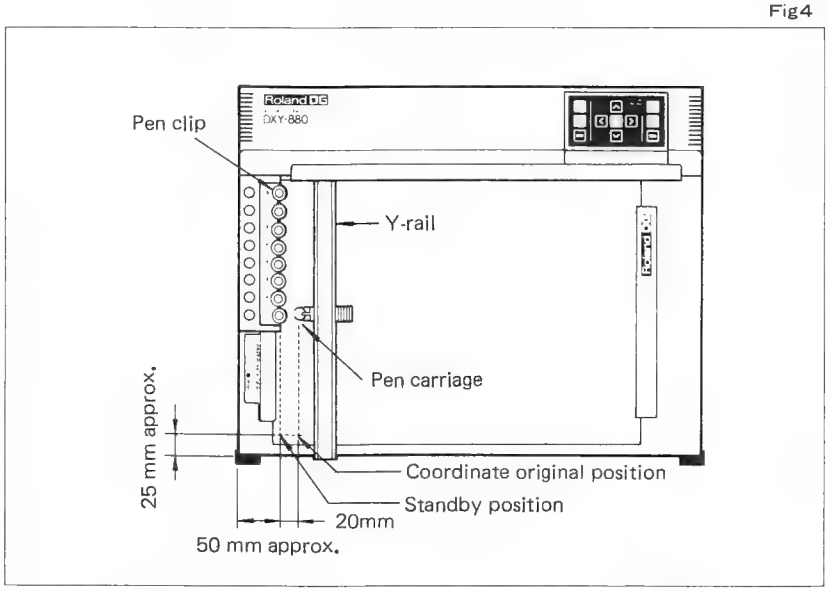
⑫ **Fast key**
Pressing this key and a positioning key will result in rapid movement of the pen.

⑬ **Pen up/down key**
When this key is pressed the pen is raised. When it is pressed again the pen is lowered.

⑭ **Pause key**
When this key is pressed during program execution plotting operation is temporarily halted. The pause is cleared by pressing the key again.

⑮ **Home key**
When this key is pressed the pen carriage returns the current pen to its pen clip and returns to the standby position. If an error occurs, pressing this key will cause the pen to return the current pen and the pen carriage to move to the standby position.

Fig4



- **Standby position**
This position is determined mechanically and is the maximum bottom left of the drawing board. Move the pen carriage to this position before turning power ON.

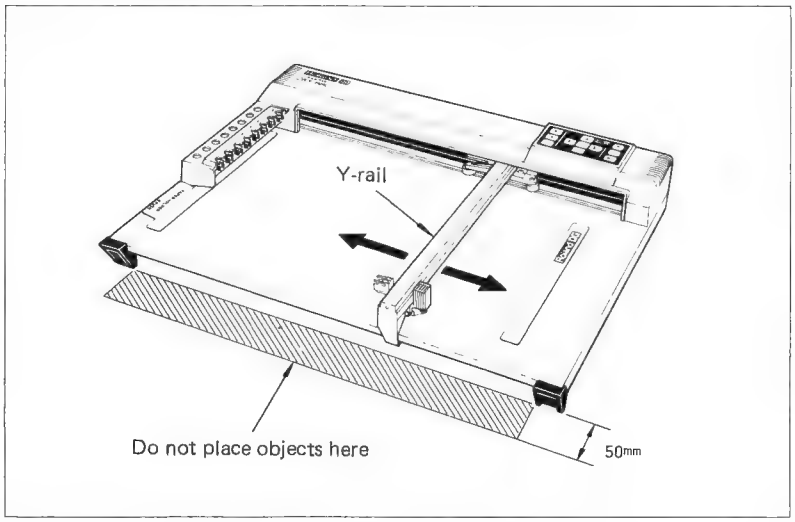
- **Coordinate original position**
The coordinate original position is at power ON.

2. Installation

The DXY-880 may be mounted either horizontally, or vertically (60°) with the aid of the built-in stand.

(1) When used horizontally

Fig5



- Install on a flat and stable base as shown in Fig. 5.
- Keep the shaded area in Fig. 5 free from objects to ensure that the Y-rail is able to move freely.

(2) When used vertically

Fig6

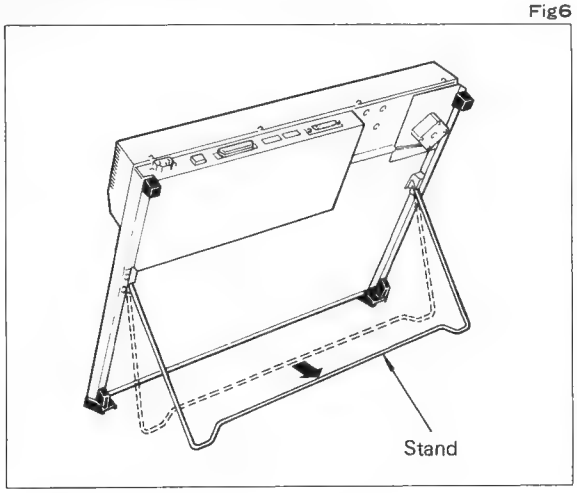
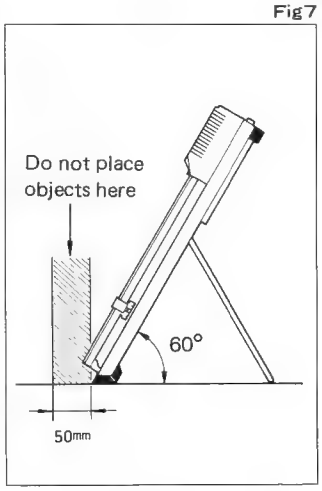


Fig7



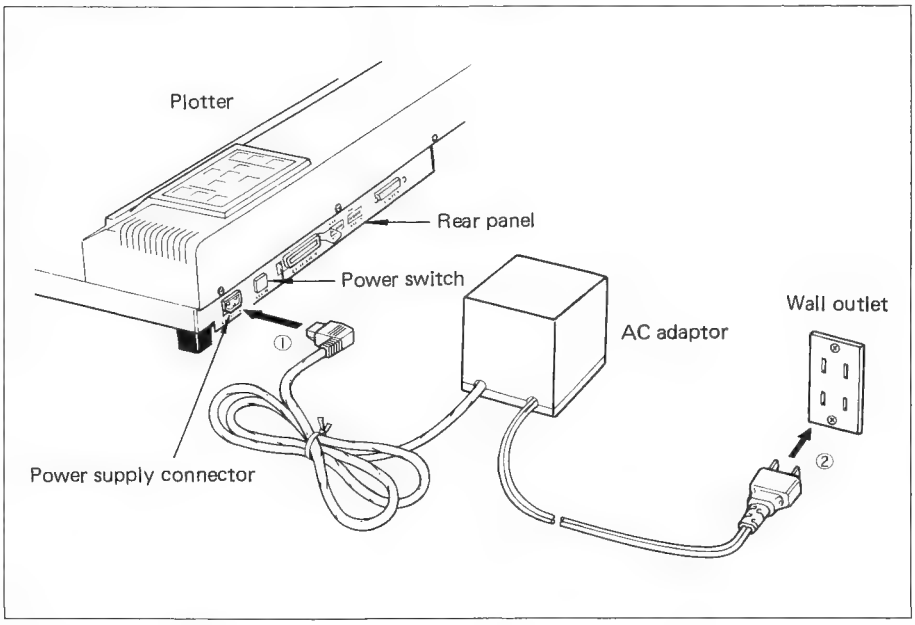
- When the stand is pulled in the direction of the arrow in Fig. 6 it will be fixed automatically.
- To fold the stand flat, push both ends gently in towards the center and then lay the stand against the rear of the drawing board.
- Keep the shaded area in Fig. 7 free from objects to ensure that the Y-rail is able to move freely.
- Always install it on a stable, horizontal base.
- Do not apply heavy loads to the plotter surfaces or the stand.

3. Connecting the power supply (AC adaptor)

(1) Make sure that the plotter power switch is OFF and then plug the AC adaptor cord into the power supply connector on the plotter.

(2) Insert the AC adaptor plug into the wall outlet.

Fig8



Note:

- When the plotter is not used, make sure that the power switch is OFF and then remove the plug from the wall outlet.

4. Fitting the pens

The supplied pens and pen holders are set in pen clips 1 to 8 in sequence.

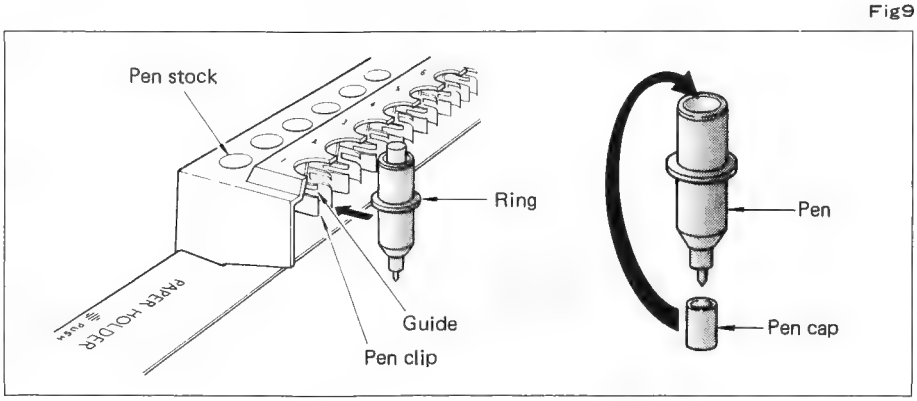
(1) Remove the caps from the pens.

(2) Gently press the rings on the pen holders into the guides in the pen clips.

Note:

- Set the pens in the pen clips, never in the pen carriage.
- If pen is not specified, drawing will be made with the No. 1 pen. A pen should, therefore, always be set in the No. 1 pen clip.

Fig9



Note:

- When pens are not used, always fit the caps to prevent the ink drying (this is particularly important with oil based pens).

Using the pen holders

Use of the pen holders permits ordinary pens on the market to be used with the plotter. These pens should be fiber tipped pens, with a maximum diameter of 9.5 mm at the point at which they fit into the holder, weigh no more than 7g, and be as short as possible.
The standard distance between the tip of the pen and the paper is 2 mm, however, this will vary with the type and shape of pen used.
Fit the pens as described below.

(1) Unscrew (in the counterclockwise direction) the top of the pen holder.
(2) Insert the pen to be used and lightly tighten the top of the pen holder to fix the pen in place.
(3) Fit to the pen carriage, adjust the distance between the tip of the pen and the paper, and then finally tighten the top of the pen holder by screwing in a clockwise direction.

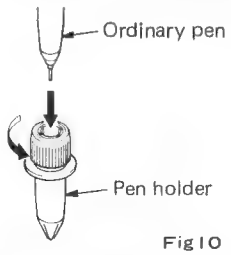


Fig 10

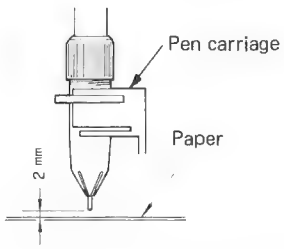


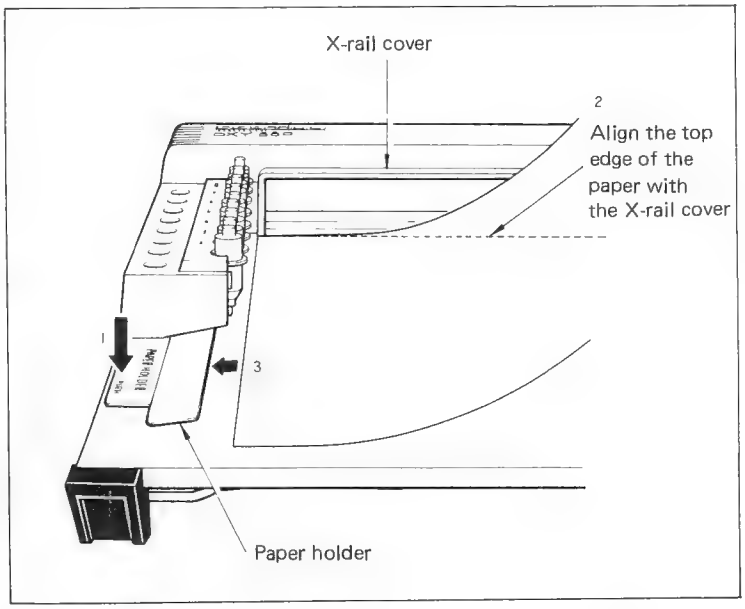
Fig 11

5. Setting the paper in place on the drawing board

A maximum of A3 size (420 x 297 mm) paper may be used. Set the paper in place as described below.
(1) Open the paper holder and insert the left edge of the paper.

(2) With A3 size paper align the top edge of the paper with the X-rail cover. With smaller sizes align the paper with the plotter while ensuring that the bottom edge does not contact the arm.

Fig 12

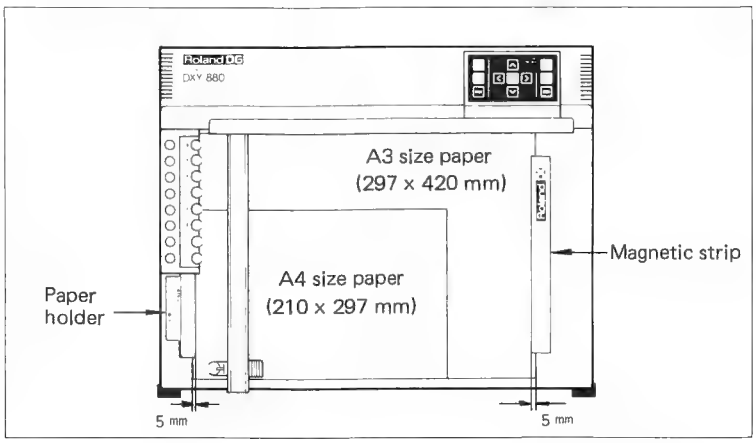


(3) Close the paper holder to fix the left edge of the paper, smooth the paper towards the right, and then fix in place with the magnetic strip. Ensure that the magnetic strip is not within the plotting area.

Note:

- If only one size of paper is to be used, apply the marking seals as a guide to positioning the paper.

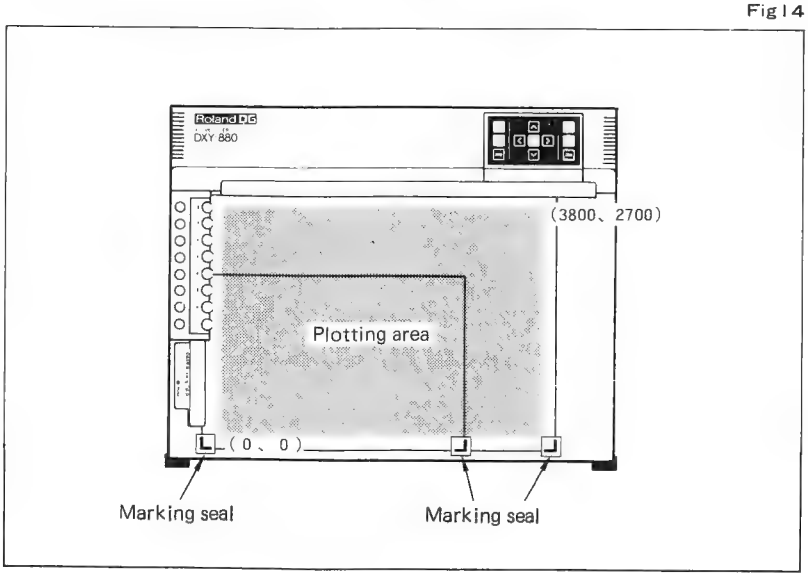
Fig 13



Note:

- The thickness of the marking seals is such that they do not affect plotting operation, however they should not be applied within the plotting area if at all possible.

Fig 14



- **Paper**

Paper used should have the proper ink absorption properties, should not stretch or shrink with variations in humidity, and should be no larger than 297 x 420 mm. Graph paper, coated paper, tracing paper, or copy paper are recommended.
OHP (overhead projector) transparent film may be used if the application requires it.
As suitable pens for the various types of paper differ, use pens as described in the following table.

Table 1

Pens \ Paper	Graph paper	Coated paper	Tracing paper	Copy paper	OHP film*
Water based fiber tipped pens	○	○	○	○	×
OHP pens	×	×	×	×	○
Water based ball point pens	○	○	○	○	×

- **Pens**

The following original pens are available (see p.1-5 for details).

Water based fiber tipped pens 0.3, 0.6 mm dia. . . . . 8 colors
OHP pens 0.3, 0.6 mm dia. . . . . 8 colors
Water based ballpoint pens . . . . . 4 colors

- When using water based fiber tipped pens and ballpoint pens, the colors appearing on the paper are determined to a large extent by the nature of the paper. Coated paper is recommended if good coloring is required.
- Paper having a rough surface will cause fibers to collect dust at the pen tips and may result in restricted flow of ink.
- Only use OHP pens with OHP film. When OHP pens are used, the drying time of the ink and the ink base, will result in considerable differences.

- **Pen thickness**

Use the 0.3 mm dia. pens for small characters, and the 0.6 mm dia. pens for large characters and filling.

- **When using OHP film**

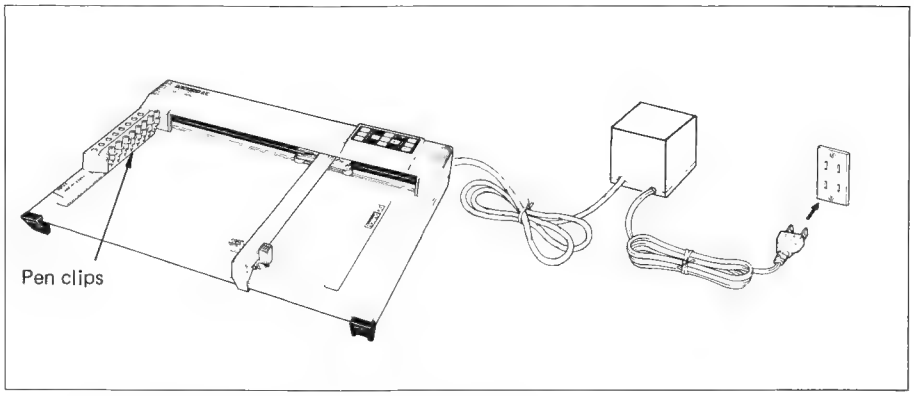
When using OHP film and OHP pens for drawing, the ink may not flow properly if the pen speed is too fast. When the DXY-880 is switched ON while pressing the [FAST] or [V] key, the maximum settable pen speed is 80 mm/sec. This speed is the optimum for drawing on OHP film.

* XY-TRK or RL-3M-121 of 3M are recommended for OHP film.

6. Operations check (self-test mode)

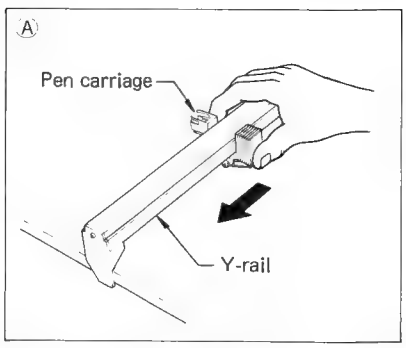
Connecting the DXY-880 to the computer, set the pens in each pen clip and check that it is operating normally.

Fig 15

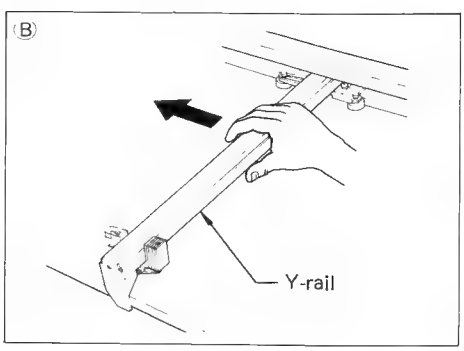


(1) Check that the DXY-880 power switch is OFF.

(2) Move the pen carriage gently to the front edge of the plotter.



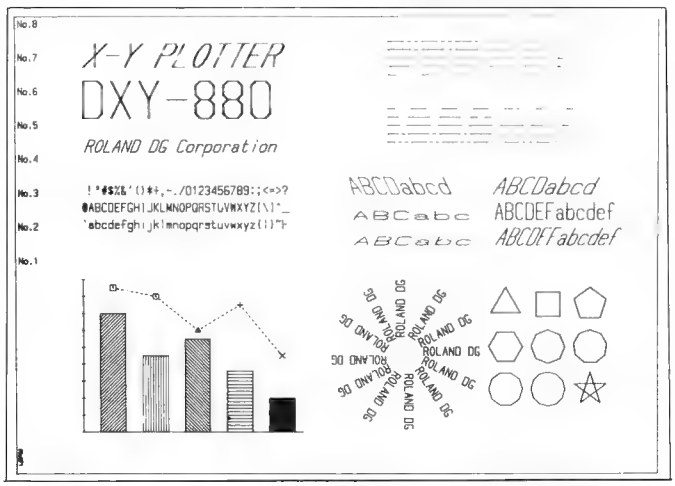
(3) While holding the attachment end of the Y-rail, move it gently to the left until it stops. The pen carriage will then be in the position shown in Fig. 17. The pen carriage must be set to this position (standby position) prior to power ON.



(4) Turn the power switch ON while pressing the [ENTER] key in Fig. 18.

(5) The plotter will operate and plot the pattern in Fig. 16.

Fig16



(6) When the positioning keys [▷], [△], [◁], [▽], [P1], [P2] are pressed, the pen will move in the required direction to the required position.

Fig17

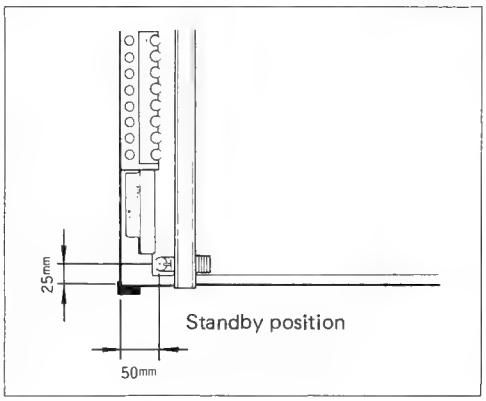
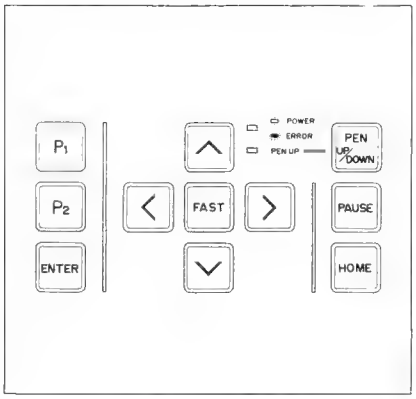


Fig18



Note:

- Do not attempt to move the arm and carriage manually when power is ON.
- If the plotting area is exceeded the pen will not move any further in that direction despite the relevant positioning key being pressed.
- Set DIP SW1 to ISO A3 size for self-test.

7. Connection with the primary personal computers.

IBM PC (5150), PC XT (5160)

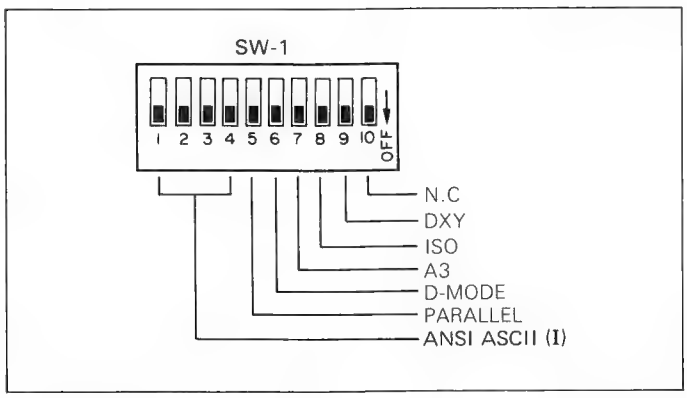
(1) Parallel connection

① An interface card is required. Use a parallel printer adaptor or a monochrome display and parallel printer adaptor.
See the operating manual of the interface card for details of installation.

② Connecting Cable: Use the IBM printer cable or Roland DG XY-IPC.

③ Make sure that the DXY-880 power is OFF and then set DIP switch 1 as shown below.

Fig.19



④ Connect the printer cable to the PARALLEL IN on the rear panel of DXY-880.

(2) Serial connection

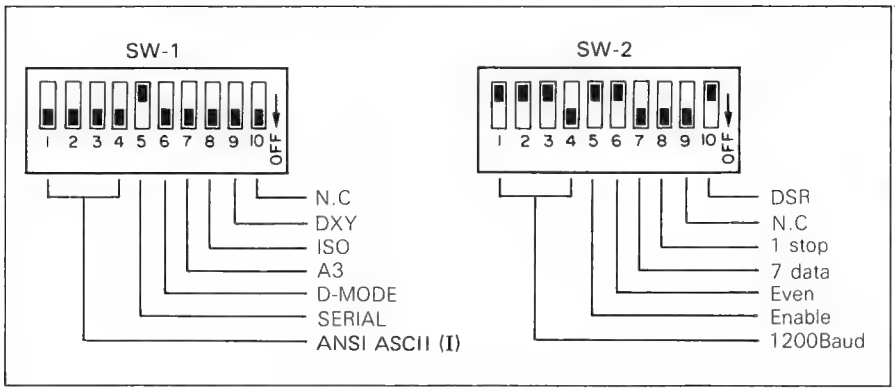
① An Interface card is required. Use either:
- IBM asynchronous communications adaptor
- Comboplus card AST Research Inc.

See the operating manual of the interface card for details of installation etc..

② Connecting cable: Use the Roland DG XY-RS-13.

③ Make sure that the DXY-880 power is OFF and then set DIP switch 1 and 2 as following.

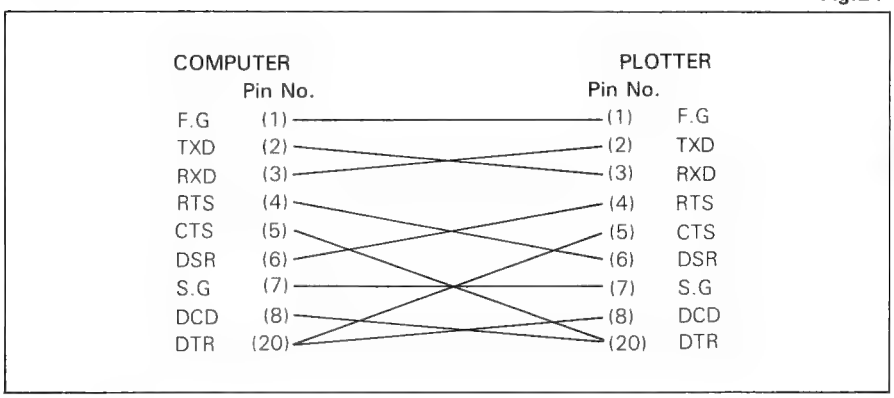
Fig.20



④ Connect the Roland DG XY-RS-13 cable to the SERIAL IN on the rear panel of DXY-880.

The internal wiring connections of the Roland DG XY-RS-13 cable are as shown below.

Fig.21



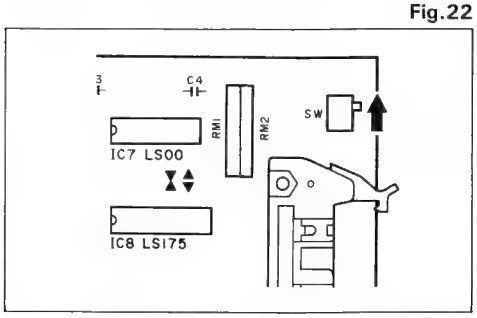
APPLE II, IIe

(1) Parallel connection

① An interface card is required. Use the Roland DG XY-APL card. See the manual supplied with the XY-APL for details of installation etc.

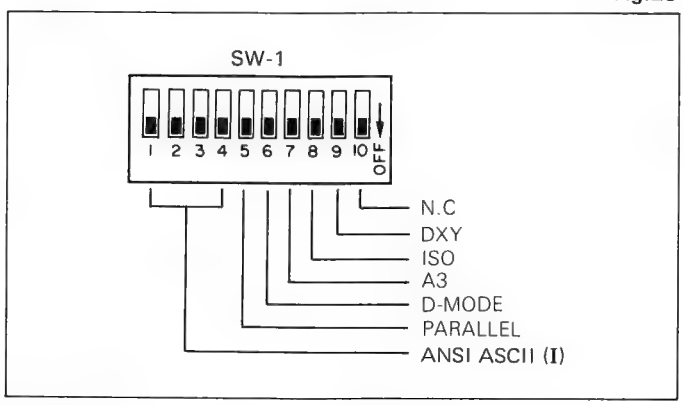
② Set the switch on the XY-APL as shown below.

Fig.22



③ Make sure that the DXY-880 power is OFF and then set DIP switch 1 as shown below.

Fig.23



④ Connect the cable from the Roland DG XY-APL to the PARALLEL IN on the rear panel of DXY-880.

This completes connection. See the Roland DG XY-APL manual for details of the interface card. Use the cable supplied with the Roland DG XY-APL.

Note:
If a parallel printer card and cable other than the XY-APL is used, the DXY-880 will not operate unless bit 7 (MSB) is set to LOW or modified.

(2) Serial connection

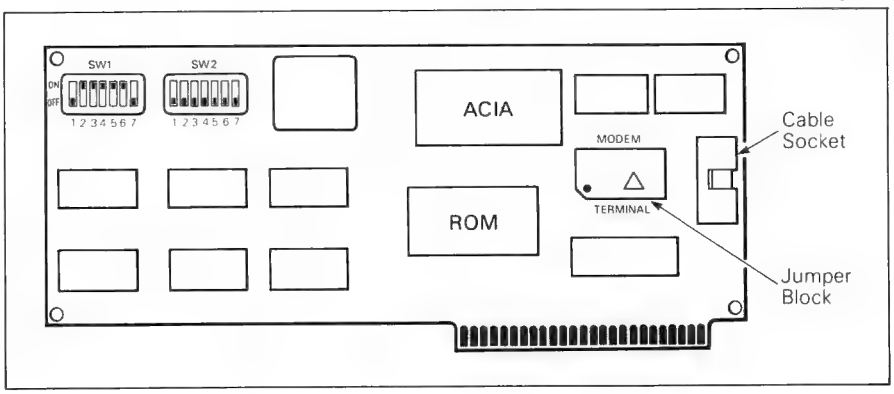
① An interface card required. Use the APPLE II Super Serial Card.

② The following example shows the case of connection at 1200 baud, even parity, stop bit 2, and data bits 7.

③ Set DIP switches 1 and 2 on the Super Serial Card as shown in Fig.24.

④ Set the jumper block so that the triangle is as shown in Fig.24. (ie. set to the communication mode).

Fig.24

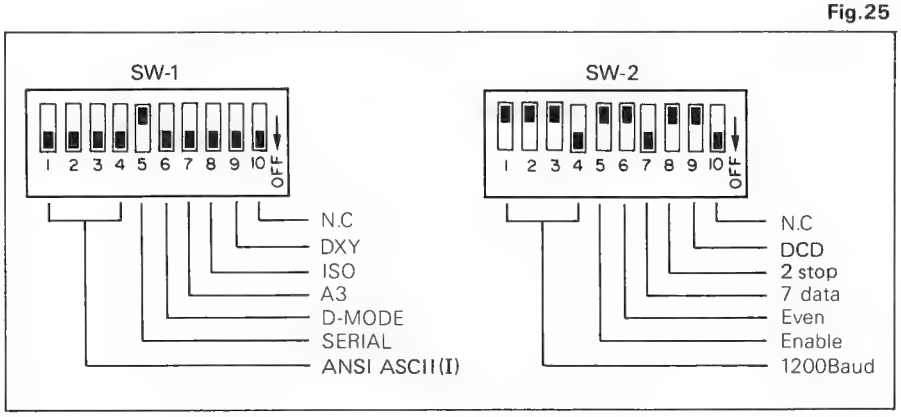


⑤ Switch the APPLE power OFF, remove the top cover and plug the Super Serial Card into slot # 2. See the Super Serial Card manual for details.

⑥ Connect the Roland DG XY-RS-11 cable to the 25-pin connector on the Super Serial Card.

⑦ Make sure that the DXY-880 power is OFF and then set DIP switches 1 and 2 as shown below.

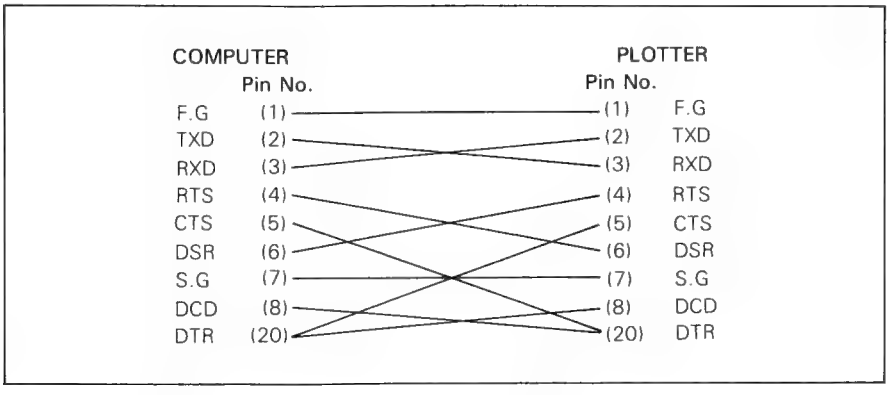
Fig.25



⑧ Connect the Roland DG XY-RS-11 cable to the SERIAL IN on the rear panel of DXY-880.

This completes connection. See the Super Serial Card manual for details of baud rate and parity checking.
The internal wiring connections of the Roland DG XY-RS-13 cable are as shown below.

Fig.26



3

OPERATIONS

1. Commands from the computer

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1. Commands from the computer

IBM PC (5150), PC XT (5160)

When DOS is started up, execute the following program, and it can protect becoming DEVICE TIME OUT. However, MODE COM is required for System Disk.

On parallel connection: `A>MODE LPT1:,,P`
On serial connection: `A>MODE COM1:12,,,,P`

(1) Parallel connection

```
10 '*** SAMPLE FOR IBM-PC ***
20 '       by Parallel
30 LPRINT "M0,0"
40 LPRINT "D3600,0,3600,2700,0,2700,0,0"
50 LPRINT "H"
60 END
```

(2) Serial connection

```
10 '*** SAMPLE FOR IBM-PC ***
20 '       by Serial
30 OPEN "COM1:1200,E,7,1,CS65535" AS #1
40 PRINT #1,"M0,0"
50 PRINT #1,"D3600,0,3600,2700,0,2700,0,0"
60 PRINT #1,"H"
70 CLOSE
80 END
```

APPLE II, IIe

The same commands are sent from the APPLE II, IIe to the DXY-880 with serial and parallel connection.

Example: Plotting a rectangle

```
10 REM *** SAMPLE ***
20 PR#2
30 PRINT "M0,0"
40 PRINT "D3600,0,3600,2700,0,2700,0,0"
50 PRINT "H"
60 PR#0
```

Note:

- With both serial and parallel connection, if PR #0 is not executed at the end of the program, all data input from the keyboard will be sent to the DXY-880 at the end of the program.

- With serial connection, the following cautions are required when output from the plotter is received with the APPLE II.
  IN #2 and PR #0 must be executed before receiving data with the INPUT statement. If IN #2 is not executed, output from the plotter cannot be received, and if PR #0 is not executed excess codes are sent to the plotter when output is received and an error occurs.

Example: Receiving plotter output with serial connection

```
10 REM *** SAMPLE ***
20 PR#2:IN#2
30 PRINT CHR$(27);".E";
40 PR#0:INPUT E
50 PR#2
60 PRINT "^OE";
70 PR#0:INPUT OE
80 IN#0
90 PRINT "SERIAL ERROR:";E
100 PRINT "RD-GL ERROR:";OE
```

2. Basics of drawing

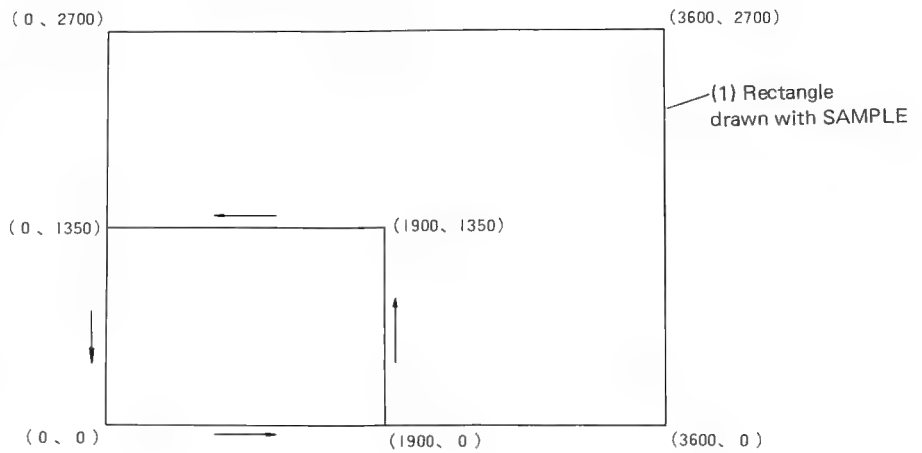
Before attempting to understand each individual command used with the plotter, the user is advised to experiment by inputting the following sample programs from the keyboard and noting the corresponding drawings output by the plotter, the uses of the various combinations of commands, and the use of parameters and coordinates.
After beginning with this investigation of the basic functions of the plotter, begin writing your own programs for the DXY-880 while referring to the explanations for each command.

- **The basics of drawing with the plotter are the D and M commands.**

(1) Drawing a rectangle using the D command
Input the following directly (without line numbers)

```
LPRINT "D1900,0,1900,1350,0,1350,0,0" RETURN
```

RETURN : Indicates that the RETURN key is to be pressed.



* Alter the LPRINT statement to suit your computer (see p.3-3).

When the RETURN key is pressed the pen is lowered and a line is drawn from position (0, 0) to (1900, 0) → (1900, 1350) → (0, 1350) → (0, 0).

Next input the following directly (without line numbers).

LPRINT "H" RETURN

When the RETURN key is pressed the pen is raised. This illustrates the fact that commands for the plotter may be input either by a program or directly from the keyboard.
When using BASIC to control the plotter, the LPRINT command is used (normally used to print characters with the normal printer). The plotter receives the data enclosed by " and " following the LPRINT statement.

Command	Parameters			
D	1900、 0	1900、 1350	0 、 1350	0 、 0
	1st X, Y coordinates	2nd X, Y coordinates	3rd X, Y coordinates	4th X, Y coordinates

Straight line draw command

The D (DRAW) command is used to specify what is to be drawn.
The parameters 1900, 0, 1900, 1350, 0, 1350, 0 and 0 are the coordinates of the end points of the lines.

Compare the lines drawn with SAMPLE and the parameters to understand the use of coordinates on the drawing board.
Four pairs of parameters [(1900, 0), (1900, 1350), (0, 1350), and (0, 0)] are used in this case, however lines may be drawn continuously with one or more pair of parameters.
An error will occur if parameters are not input for commands requiring parameters, however some commands such as the following do not require parameters.

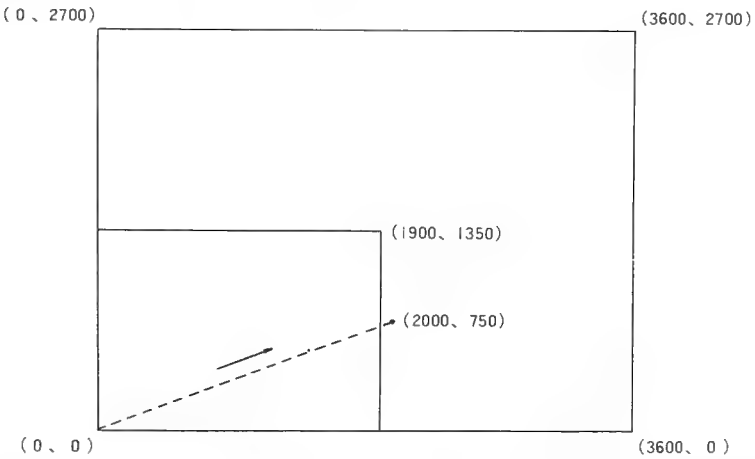
LPRINT "H" RETURN

The "H" command is used to raise the pen and move it to the coordinate original position. As the pen position was (0, 0), in this case the use of this command will only result in the pen being raised.

(2) Using the M command (pen-up movement)

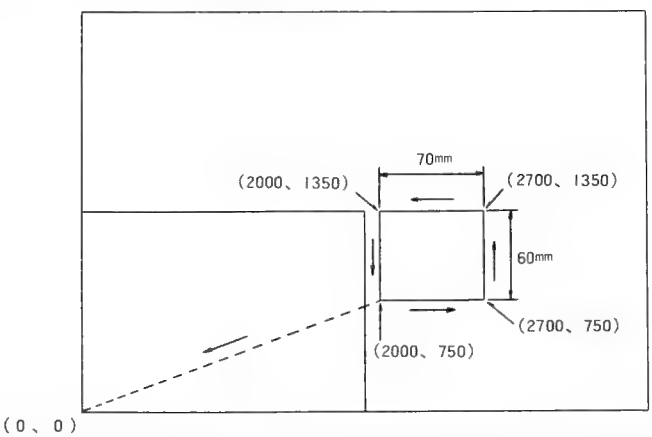
As the D command is used to begin drawing from the current pen position, use of this command alone is insufficient when a line is to be drawn from a different position. The M command is therefore used to raise the pen and move it to a new position.
Input the following.

```
LPRINT "M2000,750" RETURN
```



In the above diagram the pen is raised and moved to (2000, 750). A 70 mm (width) x 60 mm (height) rectangle is drawn in the below.

```
LPRINT "D2700,750,2700,1350,2000,1350,2000,750" RETURN
LPRINT "H" RETURN
```



The use of the D and M commands allows lines to be drawn from any position within the plotting area.

- **Relative movement**

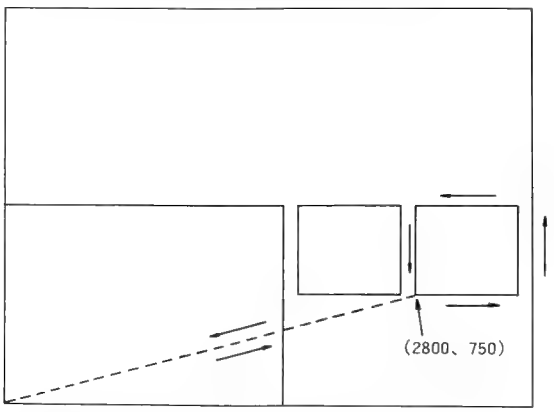
To draw the previous 70 mm (width) x 60 mm (height) rectangle at a different position, enter following to clear the program,

NEW [RETURN]

and then enter the following.

```
10 LPRINT "M2800,750"
20 LPRINT "I700,0,0,600,-700,0,0,-600"
30 LPRINT "H"
```

RUN [RETURN]



The I command moves the pen with its coordinates as (0, 0). This is term relative movement and is such that the position after movement of the pen is set as (0, 0), the movement from this position being specified as (x increment, y increment).
The advantage of this command is that, even if line 10 of the program is altered to

```
10 LPRINT "M2000,50"
```
[RETURN]

Execution again results in the same pattern being drawn at another position.
Relative movement with the pen raised is possible with the R command.
Effective use of the M, D, I, and R commands permits drawing of curves and characters in the form of combinations of short, straight lines. The DXY-880 supports a large number of commands which are extremely useful over a wide range of drawing work.

The following section explains these commands as used in drawing graphs.
First, enter to clear the previous program.

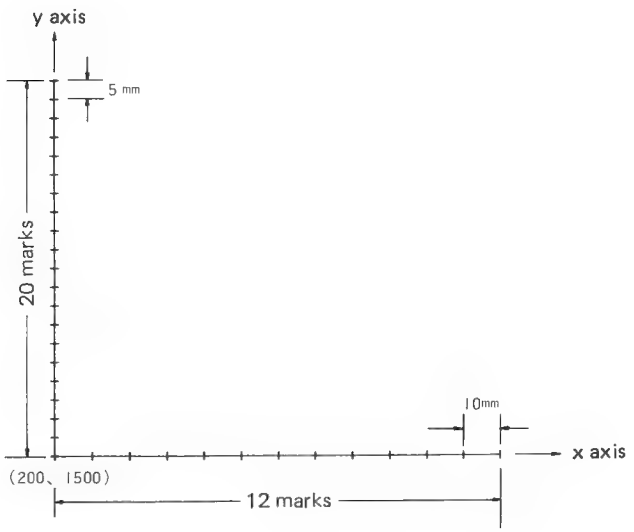
NEW [RETURN]

- **Using DXY commands**

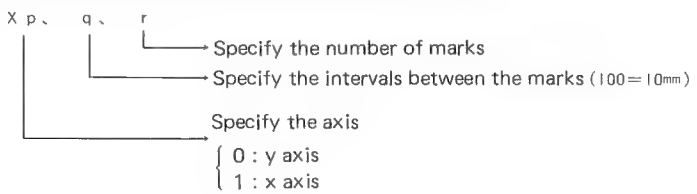
[drawing coordinates with the X command]

```
200 '**** Coordinate ****
210 LPRINT "J2"
220 LPRINT "M200,1500"
230 LPRINT "X1,100,12"
240 LPRINT "M200,1500"
250 LPRINT "X0,50,20"
```

Line 210 : Select pen No. 2
Line 220 : Move the pen to the start point
Line 230 : Draw 12 marks at 10 mm intervals on the x axis
Line 240 : Move the pen to the start point
Line 250 : Draw 20 marks at 5 mm intervals on the y axis



Draw the x and y marks specified in lines 230 and 250



[drawing a line chart with the line type command L]

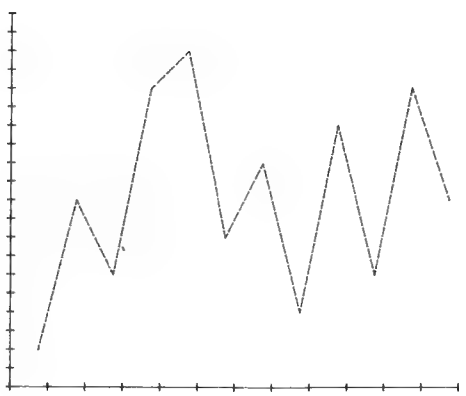
```
300 '**** Line Chart ****
310 RESTORE 10010
320 Y1=1500
330 LPRINT "J3"
340 LPRINT "L2"
350 READ A
360 LPRINT "M275,";Y1+A
370 FOR I=2 TO 12
380   READ A
390   X=I*100+175
400   Y=Y1+A
410   LPRINT "D";X;",";Y
420 NEXT I
430 LPRINT "L0"
10000 '**** Data ****
10010 DATA 100,500,300,800,900,400,600,200,700,300,800,500
```

y coordinate handled as an arithmetic variable.

x and y coordinates handled as variables.

Line 310 : Specify the start of the data to be read
Line 330 : Select pen No. 3
Line 340 : Specify dotted line
Line 350 : Read the first data item into A
Line 380 : Read data into A
Line 390 : Calculate the x coordinate
Line 400 : Calculate the y coordinate
Line 410 : Draw a line to the point indicated by the x and y coordinates
Line 430 : Clear the dotted line specification and return to the solid line specification

} Plot 12 data items as a line chart



The dotted line is specified in line 340

L p

0 : Solid line
1 : Dotted line
2 : Dotted line
3 : Single dot-dash line
4 : Single dot-dash line
5 : Double dot-dash line

★ As shown in this diagram, parameters may be handled as variables.

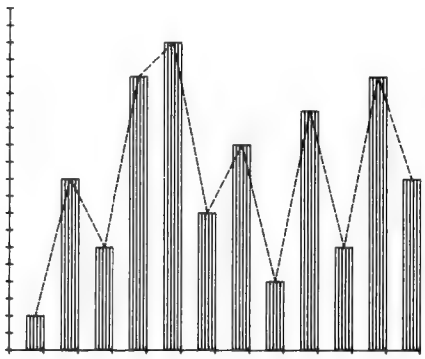
[drawing a bar chart with the hatching command T]

```
500 '**** Bar Chart ****
510 RESTORE 10010
520 Y=1500
530 LPRINT "J4"
540 FOR I=1 TO 12
550   X=I*100+150
560   LPRINT "M";X;",";Y
570   READ A
580   LPRINT "T3,50,";A;",10,3"
590 NEXT I
```

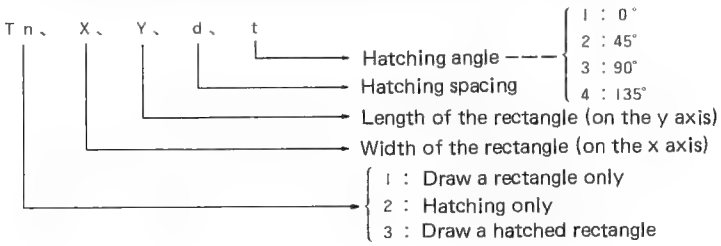
Height handled as a variable.

Line 510 : Specify the start of the data to be read
Line 530 : Select pen No. 4
Line 550 : Calculate the x coordinate
Line 560 : Move the pen to the start of the area to be hatched
Line 570 : Read the data into A
Line 580 : Hatching command

} Plot 12 data items as a bar chart



★ The hatching command draws a rectangle and hatches the area within it. It has a wide range of applications.

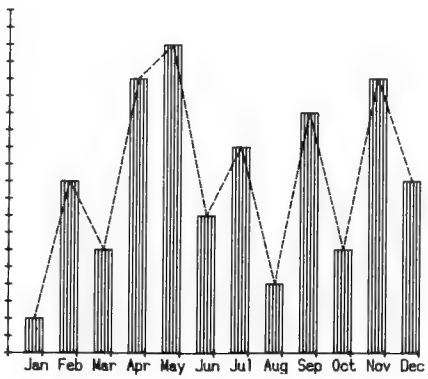


[drawing characters with the P command]

```
600 '**** Character ****
610 RESTORE 10020
620 LPRINT "J5"
630 Y=1450
640 FOR I=1 TO 12
650   X=I*100+150
660   LPRINT "M";X;",";Y
670   READ A$
680   LPRINT "P";A$
690 NEXT I
10020 DATA Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec
```

Line 610 : Specify the start of the data to be read
Line 620 : Select pen No. 5
Line 650 : Calculate the x coordinate start position of the character
Line 670 : Read the character data into A$
Line 680 : Draw the character

} Plot 12 data items

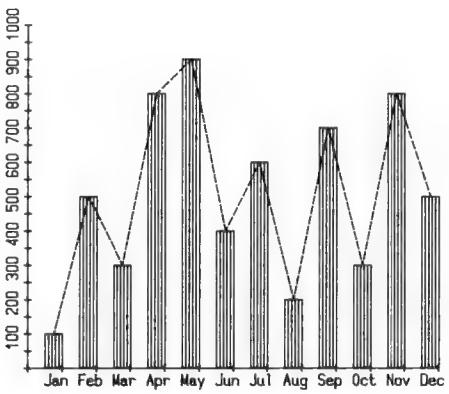


[changing the character angle with the Q command]

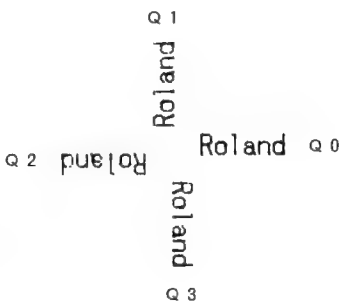
```
700 '****  Character Rotation ****
710 LPRINT "Q1"
720 X=170
730 FOR I=100 TO 1000 STEP 100
740   Y=I+1435
750   LPRINT "M";X;",";Y
760   LPRINT "P";I
770 NEXT I
780 LPRINT "Q0"
```

Line 710 : Rotate the angle at which the characters are to be drawn through 90°
Line 740 : Calculate the y coordinate start position of the character
Line 750 : Move the pen to the start position of the character
Line 760 : Draw the character
Line 780 : Return the angle at which the characters are drawn to the original setting

} Plot 12 data items



By setting Q as in Line 710 characters may be drawn in any of the four directions as shown below.

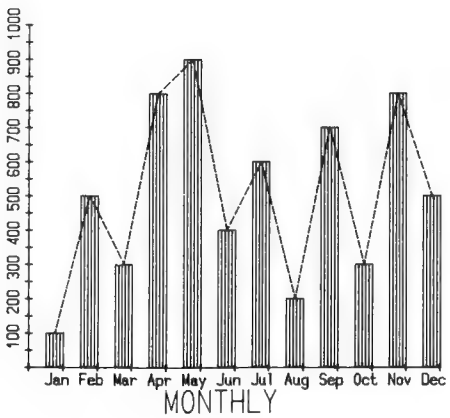


[changing the character size with the S command]

```
800 '**** Character Size ****
810 LPRINT "J6"
820 LPRINT "S7"
830 LPRINT "M600,1370"
840 LPRINT "PMONTHLY"
850 LPRINT "S3"
```

Line 810 : Select pen No. 6
Line 820 : Change the character size
Line 830 : Move the pen to the start position of the character
Line 840 : Draw MONTHLY
Line 850 : Return the character size value to the original value of 3

The (SCALE) command in Line 820 increases the character size.
Character size is set to
"S3"
at power ON.
Character size is returned to the original value of 3 in Line 850.



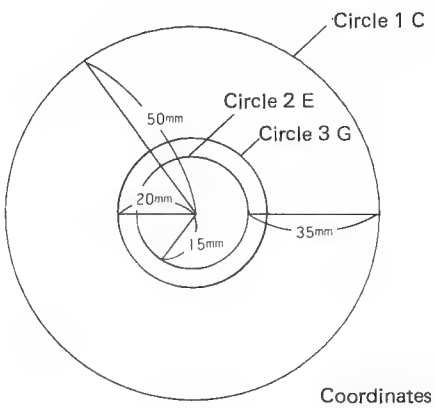
[using the C, E, and G commands to draw circles]

```
900 '**** Circle 1 ****
910 LPRINT "C2500,2000,500,0,360"
920 '**** Circle 2 ****
930 LPRINT "R-350,0"
940 LPRINT "E150,0,360"
950 '**** Circle 3 ****
960 LPRINT "J8"
970 LPRINT "A2500,2000"
980 LPRINT "G200,0,360"
```

Line 910 : Draw a circle having a radius of 50 mm centered on the point (2500, 2000)
Line 930 : Move the pen
Line 940 : Draw a circle having a radius of 15 mm starting at the pen position
Line 960 : Select pen No. 8
Line 970 : Specify the center as (2500, 2000)
Line 980 : Draw a circle having a radius of 20 mm centered on the position specified with A

These three commands may all be used to draw circles and arcs.
The last pair of parameters (0,360) specify a 360° arc.
This is specified as (0, 90) to draw a 90° arc.

The C, E and G commands differ in the manner in which the coordinates of the center of the circle are specified.
The C command uses its own parameters.
The center coordinates with the E command differ with the pen position.
The center coordinates with the G command are specified with the A command.



Coordinates of center of circle:
(2500、2000)

[drawing a pie chart using the K command to draw segmentation lines]

```
1000 '**** Pie Chart ****
1010 LPRINT "J7"
1020 A=100/12
1030 FOR I=0 TO 100 STEP A
1040   LPRINT "K";I;",200,500"
1050 NEXT I
```

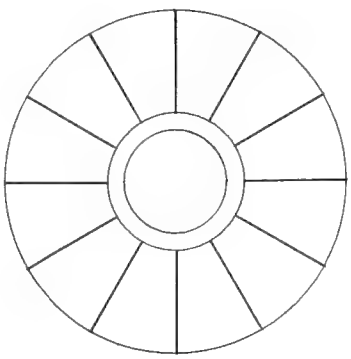
Line 1010 : Select pen No. 7

Line 1020 : Calculate the positions (in %) at which the segment line is drawn.

Line 1040 : The 0% position for segmentation lines is at the top of the circle. The lines 50 mm long and begin 20 mm from the center.

The circle is divided into 12 segments.

This sample is simplified by using 12 segments.
This command may also be used to hatch a circle.



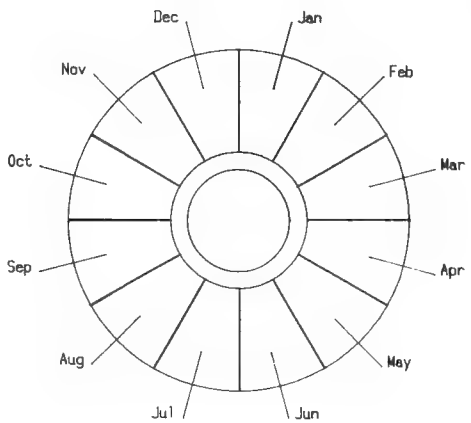
[The K command may also be used as follows]

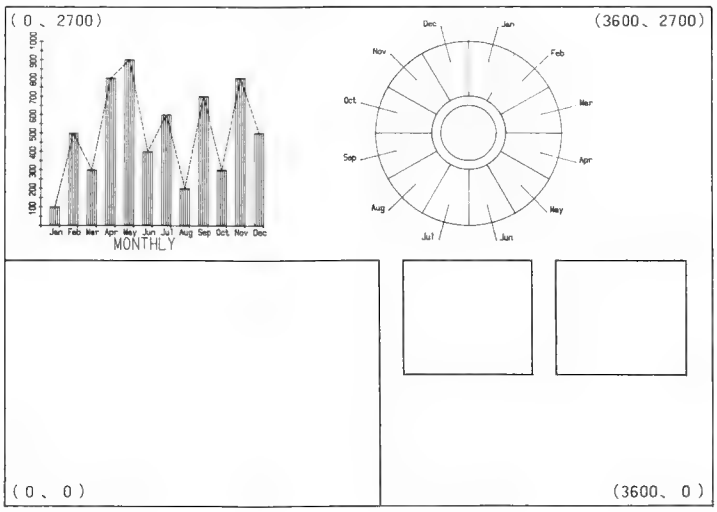
```
1200 '**** Indication Line ****
1210 RESTORE 10020
1220 LPRINT "J6"
1230 A=100/12
1240 B=20
1250 FOR I=A-4 TO 100 STEP A
1260   READ A$
1270   LPRINT "K";I;",600,400"
1280   IF I=>50 THEN B=-90
1290   LPRINT "R";B;",0"
1300   LPRINT "P";A$
1310 NEXT I
1320 '
10000 '**** Data ****
10010 DATA 100,500,300,600,500,400,600,300,700,300,300,500
10020 DATA Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec
```

Line 1210 : Specify the start of the character data to be read
Line 1220 : Select pen No. 6
Line 1240 : Parameter specifying the start point of the character
Line 1260 : Read the character data into A$
Line 1270 : Draw segmentation lines between points 40 mm and 60 mm from the center
Line 1280 : When 50% has been exceeded, the start position of the characters is altered.
Line 1300 : Draw a comment.

} Draw 12 indication lines and comment

Indication lines are drawn with the same method as used for segmentation lines, however the position of the line is altered.





Execution of these sample programs produces the result as shown above. As the next section explains applications of these programs you are advised to save them on disk or tape. Simple modifications of the parameters and data in these programs will enable their use over a wide variety of practical applications.

3. Applications

The use of the RD-GL commands with the DXY-880 adds a number of convenient functions. This section uses the programs in the previous section and explains the following functions.

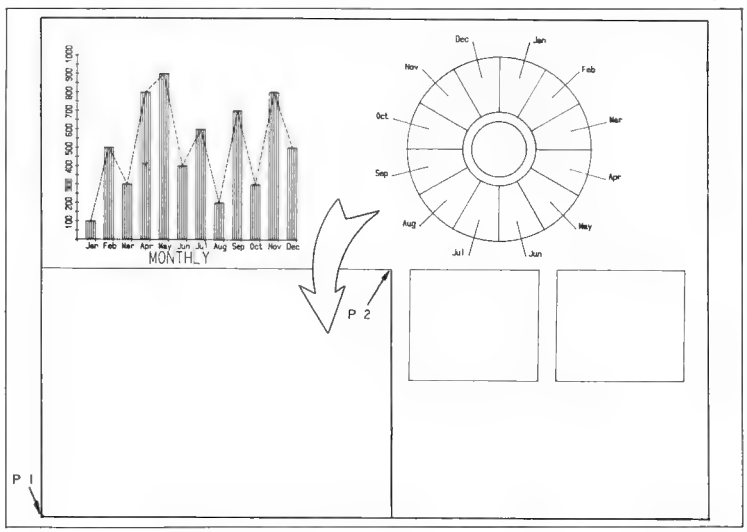
- Reducing the size of graphic patterns
- Enlarging the size of graphic patterns
- Movement of graphic patterns
- Rotation of characters
- Defining characters
- Slanted characters

The function to read pen position and status when the plotter is connected via the serial interface is also explained.

- **Reducing the size of graphic patterns**

Manual setting (from the operation panel)

Fig 1



(1) Use the positioning keys (▷ , △ , ◁ , ▽) to move the pen carriage to position P1 in Fig. 1.

(2) While pressing the [ENTER] key on the operating panel, press the [P1] key.

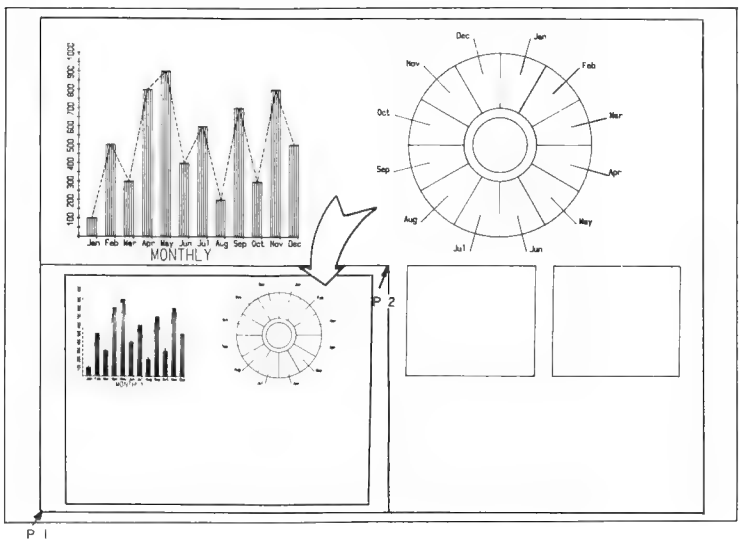
(3) Use the positioning keys (▷ , △ , ◁ , ▽) to move the pen carriage to position P2 in Fig. 1.

(4) While pressing the [ENTER] key on the operation panel, press the [P2] key.

The above operating sets the scaling points P1 and P2 (termed as manual as setting). Press the [P1] key to check. Operation is normal if the pen carriage moves to the positions set in (1) and (2).
Press the [P2] and check that the pen carriage moves to the positions set in (3) and (4). If the carriage does not move to the specified position, perform steps (1) ~ (4) again.
As each program in the previous section forms one complete program, input

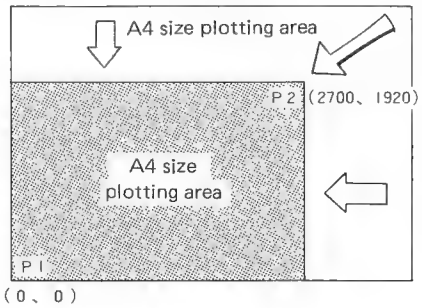
RUN [RETURN].

Fig 2



The program will draw the patterns in the previous section, in reduced size and within the rectangle bounded by P1 and P2. As P1 and P2 may set as required from the operation panel, the patterns may be drawn at any position on the paper and in any size.
This operation may also be performed within the program.

Program setting example
[Reduce the A3 size plotting area to A4]



ISO	Paper size	Plotting area
A 3	420×297(mm)	3800×2700
A 4	297×210(mm)	2700×1920

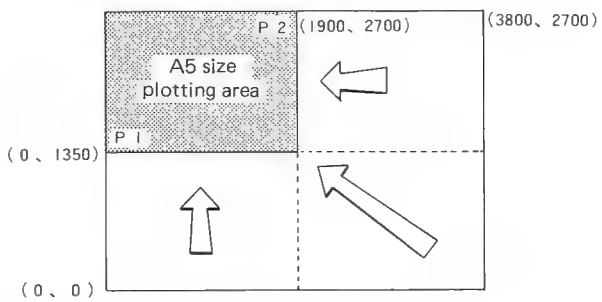
〔EXP. 1〕

```
110 LPRINT "^IP0,0,2700,1920;"
120 LPRINT "^SC0,3800,0,2700;"
130 LPRINT "^IW0,0,2700,1920;"
2000 LPRINT "^IN;"
```

Line 110 } Set to A4 size
Line 120 }
Line 130 : Set a window within the A4 size
Line 2000 : Return to the original A3 size

The pattern generated for the A3 size is reduced to A4 size by inputting these four lines in the program.
* This is convenient for plotting A3 patterns on OHP film (A4 size).

[Reduce the A3 size plotting area to A5]
(1) Reduce and draw at upper left of paper.

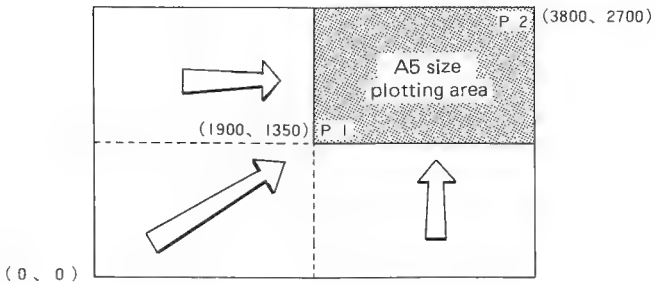


Alter Lines 110 and 130 in [EXP. 1] as follows.

〔EXP. 2〕

```
110 LPRINT "^IP0,1350,1900,2700;"
130 LPRINT "^IW0,1350,1900,2700;"
```

(2) Reduce and draw at upper right of paper.

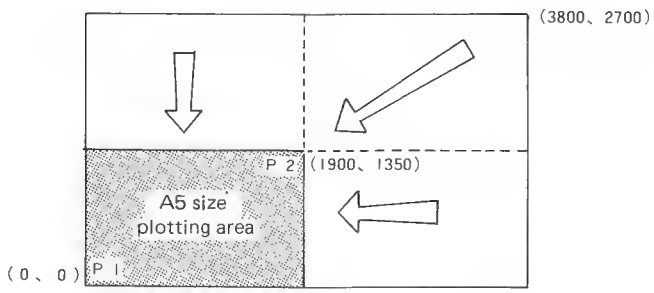


Alter Lines 110 and 130 in [EXP. 1] as follows.

[EXP. 3]

```
110 LPRINT "^IP1900,1350,3800,2700;"
130 LPRINT "^IW1900,1350,3800,2700;"
```

(3) Reduce and draw at lower left of paper.

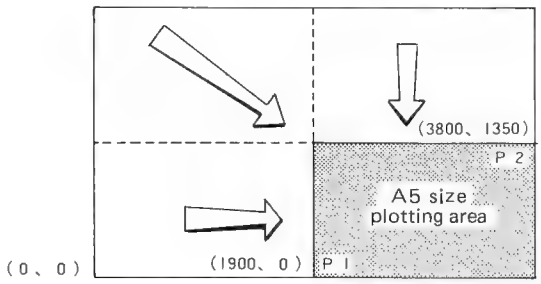


Alter Lines 110 and 130 in [EXP. 1] as follows.

[EXP. 4]

```
110 LPRINT "^IP0,0,1900,1350;"
130 LPRINT "^IW0,0,1900,1350;"
```

(4) Reduce and draw at bottom right of paper.



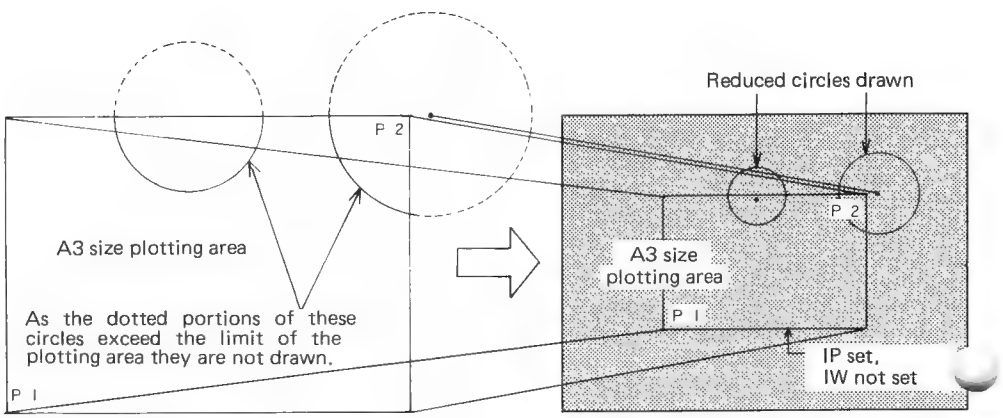
Alter Lines 110 and 130 in [EXP. 1] as follows.

[EXP. 5]

```
110 LPRINT "^IP1900,0,3800,1350;"
130 LPRINT "^IW1900,0,3800,1350;"
```

Use of the above procedures allows four A3 size patterns to be drawn on one sheet.

Note:
IP in these four examples sets a window of the same area as set with IP. If the A3 size is not exceeded in the original program, Line 130 may be omitted.
If the original graphic pattern exceeds the A3 size area, drawing is possible by reducing without setting the window.



- Enlarging the size of graphic patterns

To enlarge graphic patterns, manual setting is not possible, but possible by the command. The line, bar, and pie charts (A5 size) input in the previous section are enlarged to A3 size on the following pages.

Difference between graphic pattern and character
There are cases that the characters are not enlarged at the same ratio as the graphic pattern. The graphic patterns are enlarged or reduced according to the size ratio of the scale set by the user with SC command and the P1 and P2 scaling points set by the IP command.

$$\text{Magnification in X axis direction} = \frac{P2x - P1x}{SC\ Xmax - Xmin}$$

$$\text{Magnification in Y axis direction} = \frac{P2y - P1y}{SC\ Ymax - Ymin}$$

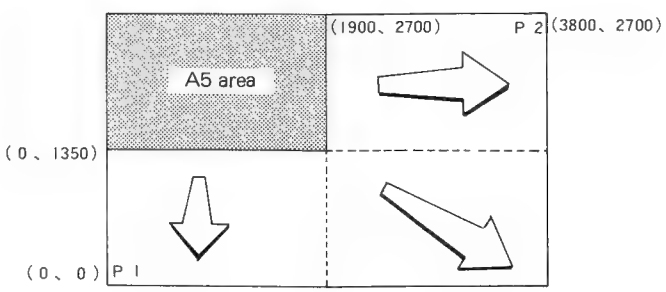
The magnification of the character size is determined by the ratio of the default values and the scaling points set by the IP command. The character size is not changed by the scale set by the SC command.

$$\text{Magnification in X axis direction} = \frac{(P2x - P1x)\ \text{Values set by user}}{(P2x - P1x)\ \text{Default value}}$$

$$\text{Magnification in Y axis direction} = \frac{(P2y - P1y)\ \text{Values set by user}}{(P2y - P1y)\ \text{Default value}}$$

[Enlarging A5 portions to A3 size]

(1) Enlarging line and bar charts

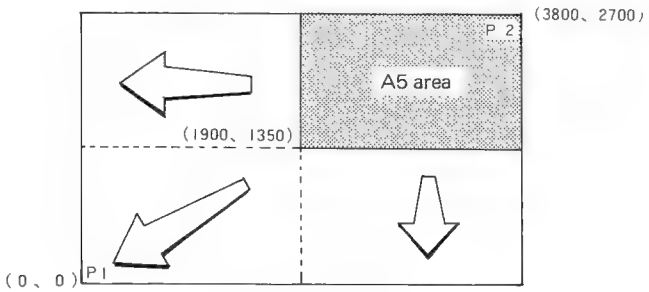


〔EXP. 6〕

```
110 LPRINT "^IP0,0,3800,2700;"
120 LPRINT "^SC0,1900,1350,2700;"
2000 LPRINT "^IN;"
```

Input the three lines shown above. If Line 130 contains the window setting (IW) delete it. The A5 portions of the line and bar charts are enlarged to A3 size. The pie chart and other portions exceed the plotting area and are therefore not drawn.

(2) Enlarging pie chart (top right portion enlarged)



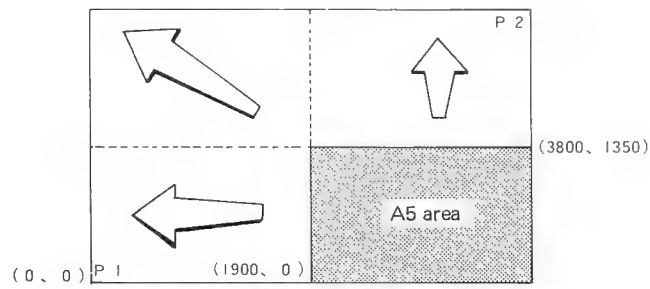
Alter Line 120 as follows.

〔EXP. 7〕

```
120 LPRINT "^SC1900,3800,1350,2700;"
```

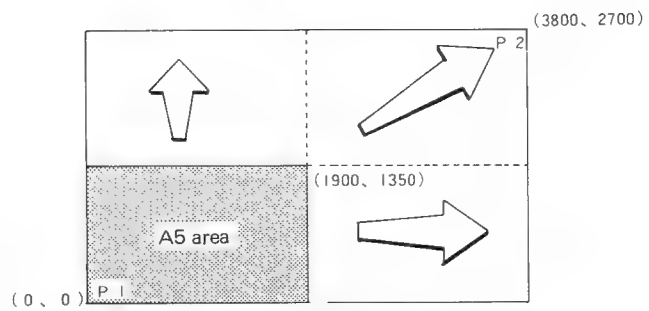
Only the pie chart portion is enlarged, the line and bar charts etc. exceed the plotting area are therefore not drawn.
*See the next section for details of enlarging other portions.

- Enlarge bottom right portion



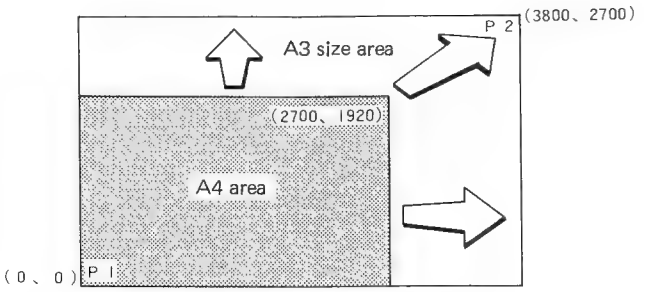

```
LPRINT "^SC1900,3800,0,1350;"
```

- Enlarge bottom left portion




```
LPRINT "^SC0,1900,0,1350;"
```

- Enlarge A4 portion to A3 size

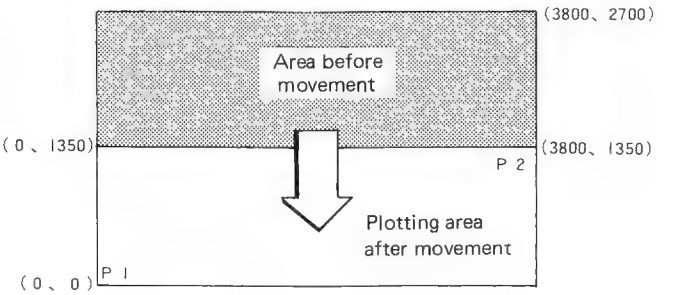



```
LPRINT "^SC0,2700,0,1920;"
```

- Movement of graphic patterns

Patterns may also be moved without changing their scale. This cannot be set manually but must be set with the command.

(1) Parallel downward movement



[EXP. 8]

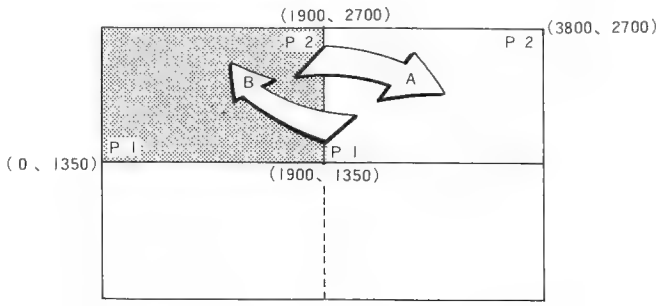
```
110 LPRINT "^IP0,0,3800,1350;"
120 LPRINT "^SC0,3800,1350,2700;"
130 LPRINT "^IW0,0,3800,1350;"
2000 LPRINT "^IN;"
```

Line 110 } Move drawing downwards
Line 120 }
Line 130 : Set window in same area as with IP
Line 2000 : Return to original setting

Input of these four lines results in the graphic pattern drawn in the shaded area above being moved downwards. The window setting in Line 130 will prevent drawing if y = 2700. Delete Line 130 if drawing in excess of this value is required.

(2) Exchanging drawing positions

The use of parallel movement enables the drawing positions of the line, bar and pie charts input in the previous section to exchange.



Ⓐ Movement of the line and bar charts (B5 portions moved to right)

〔EXP. 9〕

```
110 LPRINT "^IP1900,1350,3800,2700;"
120 LPRINT "^SC0,1900,1350,2700;"
130 LPRINT "^IW1900,1350,3800,2700;"
```

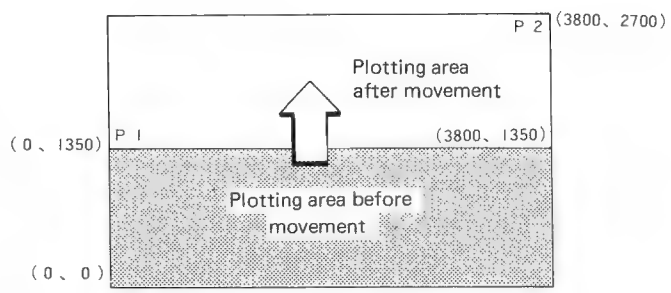
Ⓑ Movement of the pie chart (B5 portions moved to left)

```
851 LPRINT "^IP0,1350,1900,2700;"
852 LPRINT "^SC1900,3800,1350,2700;"
853 LPRINT "^IW0,1350,1900,2700;"
```

The line and bar charts are moved to the right with Lines 110 ~ 130, and the pie chart is moved to the left with Lines 851 ~ 853, the result being that the left and right portions are exchanged.

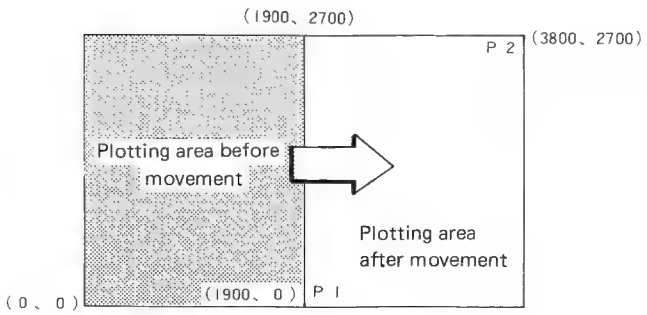
*See the next section for details of other movement.

- Parallel upward movement



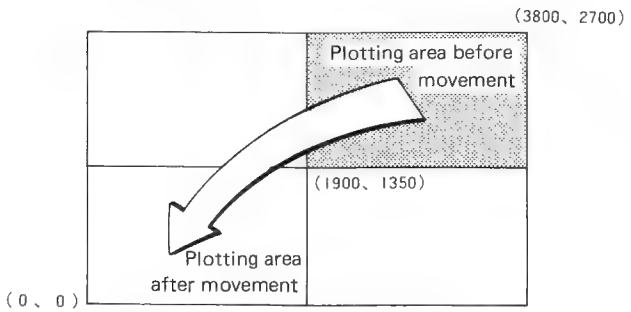

```
LPRINT "^IP0,1350,3800,2700;"
LPRINT "^SC0,3800,0,1350;"
LPRINT "^IW0,1350,3800,2700;"
```

- Parallel movement to the right




```
LPRINT "^IP1900,0,3800,2700;"
LPRINT "^SC0,1900,0,2700;"
LPRINT "^IW1900,0,3800,2700;"
```

- Parallel diagonal movement




```
LPRINT "^IP0,0,1900,1350;"
LPRINT "^SC1900,3800,1350,2700;"
LPRINT "^IW0,0,1900,1350;"
```

Application of this sample program permits further movement and reduction/enlargement of graphic patterns.

* Transfer Lines 110 ~ 130 to the start of the drawing program.
* Transfer Line 2000 before the END statement of the drawing program.
* After using the commands to the plotting area and scale, reset to the original values unless the new values are still required.

★ Initial setting with IN

Executing Line 2000 has the same effect as executing the following.

```
LPRINT "^IP0,0,3800,2700;"  or  "^IP;"
LPRINT "^SC0,3800,0,2700;"  or  "^SC;"
LPRINT "^IW0,0,3800,2700;"  or  "^IW;"
```

A number of commands are available to simplify the drawing of characters. Firstly, save the programs you have input into the computer on disk or tape and then delete the program by entering.

NEW [RETURN]

- Rotation of characters

(EXP. 10)

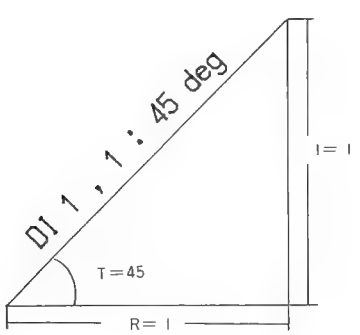
```
100 REM *** Character rotation ***
110 X=700:Y=2000
120 LPRINT "S4"
130 R=1  :I=1  :T=45  :GOSUB 240
140 R=0  :I=1  :T=90  :GOSUB 240
150 R=-1 :I=1  :T=135 :GOSUB 240
160 R=-1 :I=0  :T=180 :GOSUB 240
170 R=-1 :I=-1 :T=225 :GOSUB 240
180 R=0  :I=-1 :T=270 :GOSUB 240
190 R=1  :I=-1 :T=315 :GOSUB 240
200 R=1  :I=0  :T=0   :GOSUB 240
210 LPRINT "S3"
220 LPRINT "H"
230 END
240 LPRINT "M";X;",";Y
250 LPRINT "^DI";R;",";I
260 LPRINT "P␣␣␣DI";R;",";I;":";T;"deg"
270 RETURN
```

Line 120 : Set character size to 4
Line 130) Sample data
Line 200)
Line 210 : Set character size to the original value of 3
Line 240 : Set the drawing position
Line 250 : Set the drawing direction
Line 260 : Draw the characters and variables

The Q command described in the previous section is used here in Line 220.

```
"^DI";R;",";I
```

Further specification of the R and I parameters for this command allows detailed specification of drawing direction for characters.



Relationship with Q command

Q command	DI command	Rotation angle
Q0	DI 1, 0	0°
Q1	DI 0, 1	90°
Q2	DI – 1, 0	180°
Q3	DI 0, – 1	270°

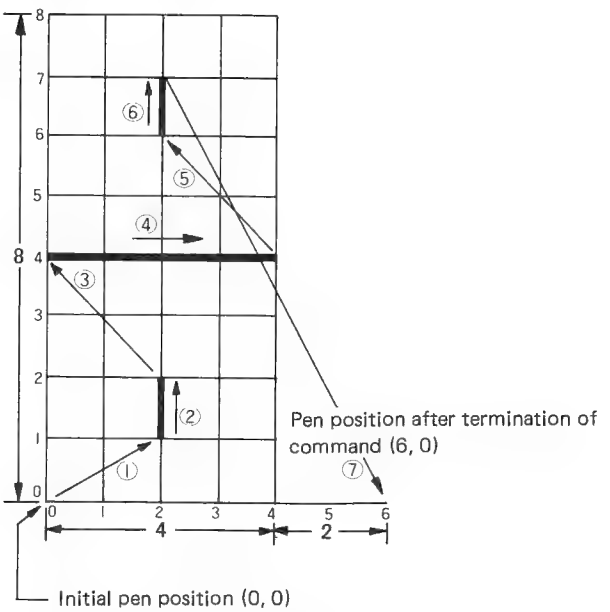
The relationship among R, I, and T is as follows.

$$\tan T = \frac{I}{R}$$

Setting of R and I permits setting of the angle at which the characters are drawn.

- **Defining characters**

Characters not in the standard character set may be defined by the user as follows.



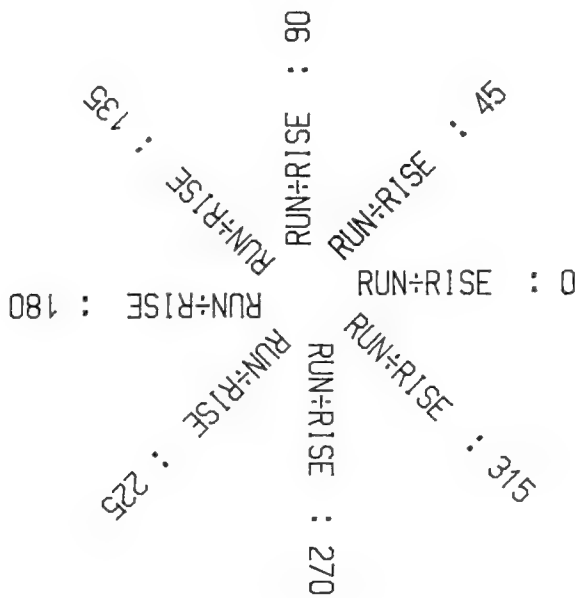
The following program is used to define the character " ÷ ".

[EXP. 11]

```
110 X=2000:Y=2000
260 LPRINT "P␣␣␣ RUN"
270 GOSUB 300
280 LPRINT "PRISE␣␣:";T
290 RETURN
300 LPRINT "^UC-99,2,1,99,0,1,-99,-2,2,99,4,0,-99,-2,2,99,0,1,-99,"
310 RETURN
```

Pen up movement
Pen up movement
Pen up movement
Pen up termi-
na
1
2
3
4
5
6
7
Pen down movement
Pen down movement
Pen down movement

The ^UC and following parameters in the Line 300 are used to define the " ÷" character. Parameters are in sets of three, 7 sets being used. The −99 in each set specifies pen-up, 99 specifies pen-down, and the following two numbers are the x and y increments.
The character is drawn by calling Line 300 in the form of a subroutine.
When defined with ^UC it is handled as a character so that size may be altered, and characters defined for rotation and slant can be printed as required.



- **Slanted characters**

Save the current program into disk or tape and enter (NEW [RETURN]) to delete it and input the following program.

[EXP. 12]

```
100 REM *** Slanted character ***
110 X=800:Y=1200
120 LPRINT "S5"
130 FOR I=1.2 TO -1.2 STEP -.3
140   LPRINT "^SL";I          ---------- Slant set
150   LPRINT "M";X;",";Y
160   LPRINT "PRoland␣␣␣"
170   LPRINT "^SL;"           ---------- Slant cleared
180   LPRINT "PSL";I
190   Y=Y-80
200 NEXT I
210 LPRINT "H"
```

Roland SL 1.2
Roland SL .9
Roland SL .6
Roland SL .3
Roland SL 0
Roland SL-.3
Roland SL-.6
Roland SL-.9
Roland SL-1.2

* Set " ^DI " and " ^SL ", and then initialize after drawing is completed unless these settings are still required.

- **When the computer and DXY-880 are connected via serial interface (RS-232C)**

Connection via serial interface offers further convenient functions. See the table in "Connection to various computers" on p.2-13 for details.

- **Pen position and status**

A command is available which enables the user to check the position of the pen on the plotter.
Save the current program in tape or disk and enter (NEW [RETURN]).

The following explains the case when the computer and plotter are connected via the serial interface. Input as follows after referring to p.3-3 to determine the substitute commands for your computer.

[EXP. 13]

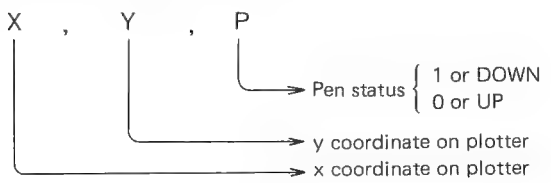
```
100 REM *** INPUT X,Y,PEN ***
120 OPEN "COM1:1200,E,7,1,CS65535" AS #1
130 PRINT #1,"D1600,2000"
140 PRINT #1,"^OA;"
150 INPUT #1,X,Y,P
160 IF P=1 THEN P$="DOWN":GOTO 180
170 P$="UP"
180 PRINT "X=";X;" Y=";Y,"PEN=";P;"(";P$;")"
190  END
RUN [RETURN]
```

When the above program is input, the plotter will move the pen to the point (1600, 2000) and the following will appear on the display.

```
X=1600   Y=2000   PEN=1(DOWN)
```

The ^OA command in Line 140 is used to output the coordinates of the pen position and the pen status (UP or DOWN). The pen position and status is then read into the computer with Line 150.

Parameters are in the following order.




```
190 GOTO 140
```

Alter Line 190 to the above and move, and raise and lower, the pen with the positioning keys on the operation panel. The computer will read the current pen position and status.

This section has used the RD-GL commands for drawing and applications. A large number of further applications are possible, however the user is advised to become accustomed to use of the plotter and then use the following section to obtain more detailed information for further applications.

4. Application of software on the market

The DXY-880 can be used with many software packages on the market. Followings are how to use and set up them with DXY-880:

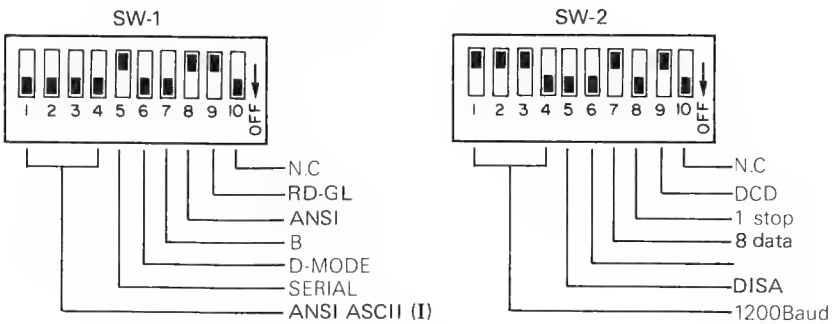
IBM PC

(1) Lotus 1 2 3
(serial connection, 1200 baud, even parity, 7 data bits, 1 stop bit)

Computer side:

[CONFIGURE]
Graphics device : H/P 7470A
Interface : Serial Port
Baud rate : 1200

DXY-880 side:

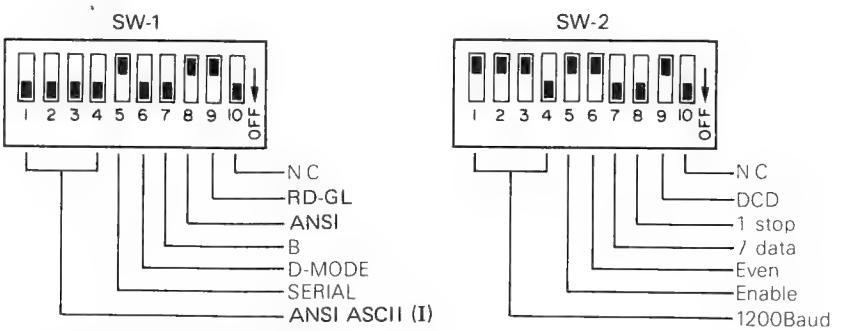


(2) Super calc 3
(serial connection, 1200 baud, even parity, 7 data bits, 1 stop bit)

Computer side

[DEVICE SELECTION]
Plotters : H/P 7475A
[OPTIONS]
Serial Options : Com number 1.
Baud Rate 1200
Parity Even
Data bits 7.
stop bits 1.

DXY-880 side



Lotus 1 2 3 is trademark of Lotus Development Corporation.
Super Calc 3 is trademark of SORCIN CORP.
HP is trademark of Hewllet-Packard Company

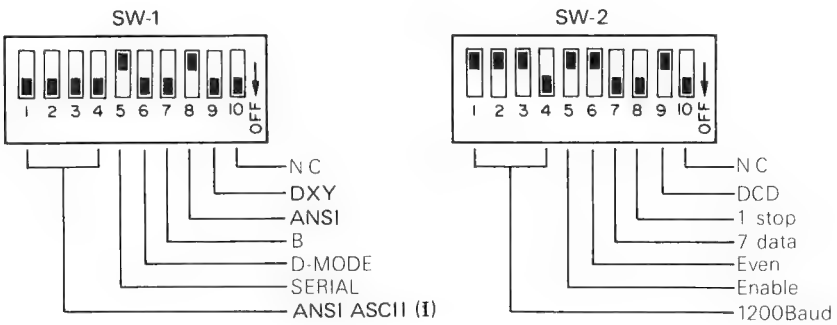
(3) BPS Business Graphics
(serial connection, 1200 baud, even parity, 7 data bits, 1 stop bit)

Computer side
Start up the DOS and input

A > MODE COM1:1200,E,7,1,P.
before starting the BPS

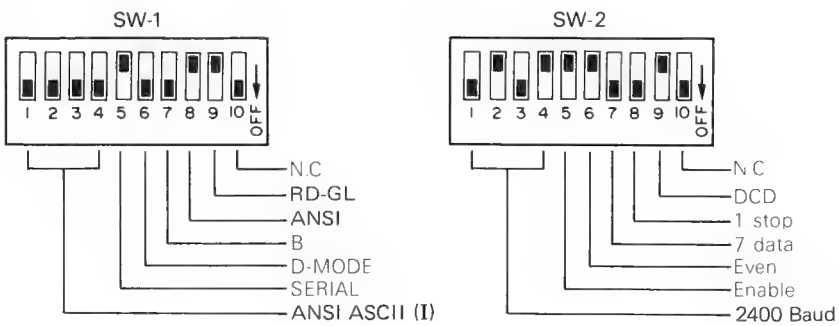
SET DEF D A:
SET OUTPUT UNIT SERIAL1
SET DEVICE ROLANDDXY800

DXY-880 side



(4) PEACHTREE SOFTWARE Business Graphics System
(serial connection, 2400 baud, even parity, 7 data bits, 1 stop bit)

DXY-880 side



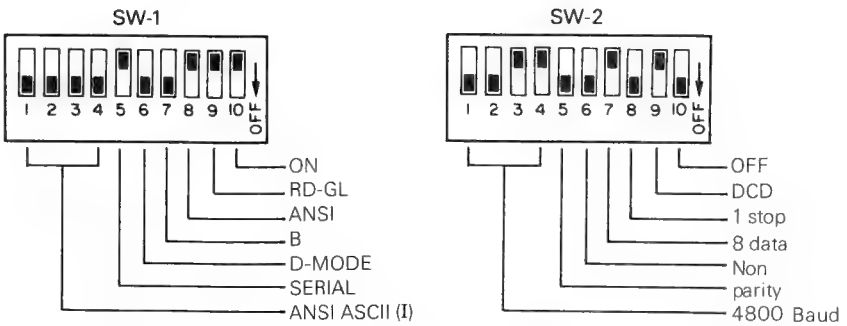
BPS BUSINESS GRAPHICS is trademark of Business & Professional Software, Inc.
PEACHTREE SOFTWARE is trademark of Peachtree Software Incorporated.

(5) Lotus Symphony

Computer side
[Hardware]

Printer : H/P 7475A
Inrerface : Serial port
Baud rate : 4800

DXY-880 side



Note: Make sure to turn on No.10 of SW-1.

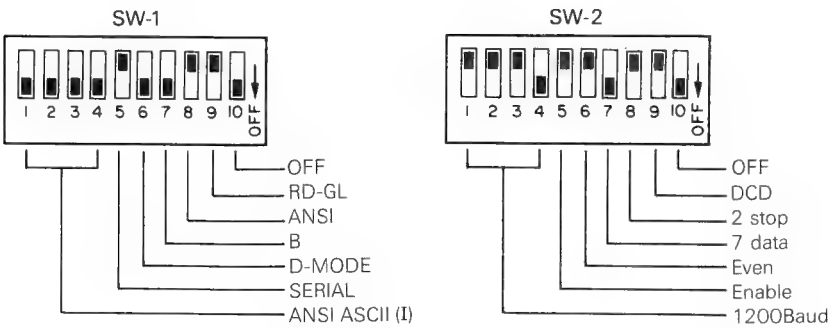
Symphony is trademark of Lotus Development Corporation

APPLE II/IIe

(6) Pfs : GRAPH

Computer side
Set the Super Serial Card as shown on P2-16, Fig.24.

DXY-880 side



Pfs GRAPH is trademark Software Publishing Corporation

4

DXY COMMANDS

The DXY commands are based on the commands used with the DXY series of plotters, however they have been improved to enable all programs for the DXY-800 to use this mode.
Use of the "^" command to call RD-GL commands from the DXY mode enables the drawing programs written in the DXY mode to be high level drawing programs.

*DXY-880 commands may be input in either upper or lower case characters.

"H" COMMAND Home

● **Function**

Moves the pen to the coordinate original position (0, 0) in the pen up status.

● **Format**

H or h

● **Example**

```
LPRINT "H"
LPRINT "h"
```

● **Explanation**

Moves the pen to the coordinate original position (0, 0) in the pen-up status. This command may be used to clear errors occuring in the plotter. It requires no parameters, any parameter specified are ignored.
When the pen carriage is at the standby position, the No.1 pen is picked up and moved to the coordinate original position.

The coordinate original position is normally at the bottom left, however, as it is altered to (0, 0) with scaling, execution of the "H" command results in it being moved to a position relative to (0, 0).

"D" COMMAND Draw

● **Function**

Draws lines (with the pen down) using the absolute coordinate system.

● **Format**

D x1, y1, x2, y2 ... xn, yn

● **Example**

```
LPRINT "D 1000, 1500"
```

● **Parameter range**

−16383 to +16383

● **Related commands**

L, B, ^LT

● **Explanation**

Draws lines (starting at the current pen position) between points (x1, y1), (x2, y2) ... (xn, yn). All coordinates are absolute coordinates and any number of coordinates may be specified in the form (x coordinate, y coordinate). Parameters must be in the range −16383 to +16383, and decimal fractions are rounded up or down to the nearest integer. The "+" sign may be omitted.
If a parameter outside the range is specified, if no parameter is specified, or if only one parameter is specified, an error occurs.
When an odd number of parameters (3 or more) has been specified, the pairs of parameters are executed in sequence and the last odd parameter results in an error.
If the specified coordinates are within the plotting area the pen moves as specified, however if they are outside the plotting area, the line will be drawn to the edge of the plotting area the pen raised.

*Not necessary to have a period between commands and parameters; however, each parameter must be separated by "," or a space.

*As BASIC automatically inserts CR and LF at the end of the PRINT and LPRINT statements as terminators, these are not included in the example above.

"M" COMMAND Move

- **Function** — Moves the pen in the pen-up status within the absolute coordinate system.
- **Format** — Mx, y
- **Example** — LPRINT "M 1000, 1500"
- **Parameter range** — −16383 to +16383
- **Explanation**

Moves the pen in the pen-up status to the point specified by the coordinates (x, y). All coordinates are absolute coordinates and any number of coordinates may be specified in the form (x coordinate, y coordinate). Parameters must be in the range −16383 to +16383, and decimal fractions are rounded up or down to the nearest integer. The "+" sign may be omitted. If a parameter outside the range is specified, if no parameter is specified, or if only one parameter is specified, an error occurs.
When an odd number of parameters (3 or more) has been specified, the pairs of parameters are executed in sequence and the last odd parameter results in an error.
If the specified coordinates are outside the plotting area the pen will not move; however, when the processed line data is within the plotting area, the pen will begin moving again as specified.

"I" COMMAND Relative Draw

- **Function** — Moves the pen in the pen-down status within the relative coordinate system.
- **Format** — I Δx1, Δy1, Δx2, Δy2, ... Δxn, Δyn
- **Example** — LPRINT "I 500, 1000"
- **Parameter range** — −16383 to +16383
- **Related commands** — L, B, ^LT
- **Explanation**

Draws a straight line from the current position to a point specified with the x and y increments (Δx1, Δy1) and then draws another straight line from the resultant position to a point specified with the next x and y increments (Δx2, Δy2).
All coordinates are relative coordinates and any number of coordinates may be specified in the form (x coordinate increment, y coordinate increment). Parameters must be in the range −16383 to +16383, and decimal fractions are rounded up or down to the nearest integer. The "+" sign may be omitted. If the specified coordinates exceed the absolute plotting area following, operation is not guaranteed.
If a parameter outside the range is specified, if no parameter is specified, or if only one parameter is specified, an error occurs.
When an odd number of parameters (3 or more) has been specified, the pairs of parameters are executed in sequence and the last odd parameter results in an error.

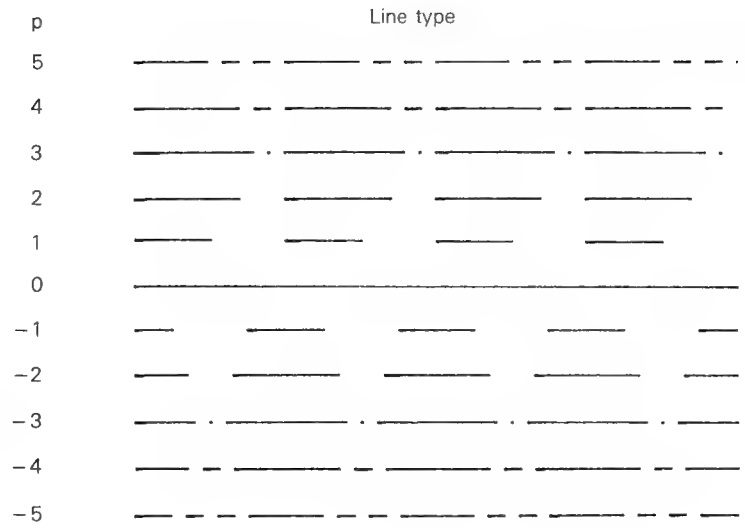
"R" COMMAND Relative Move

- **Function** — Moves the pen in the pen-up status within the relative coordinate system.
- **Format** — RΔx, Δy
- **Example** — LPRINT "R 500, 1000"
- **Parameter range** — −16383 to +16383
- **Explanation** — Moves the pen in the pen-up status from the current position to a point specified with the x and y increments (Δx1, Δy1). All coordinates are relative coordinates and any number of coordinates may be specified in the form (x coordinate increment, y coordinate increment). Parameters must be in the range −16383 to +16383, and decimal fractions are rounded up or down to the nearest integer. The "+" sign may be omitted, however if the specified coordinates exceed the absolute plotting area following operation is not guaranteed. If a parameter outside the range is specified, if no parameter is specified, or if only one parameter is specified, an error occurs.
When an odd number of parameters (3 or more) has been specified, the pairs of parameters are executed in sequence and the last odd parameter results in an error.

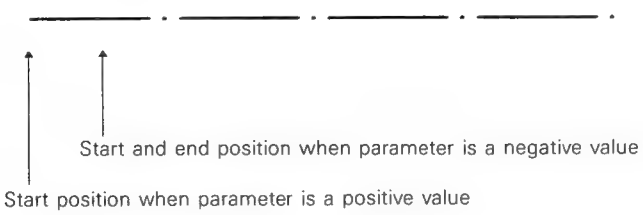
"L" COMMAND Line Type

- **Function** — Sets line type.
- **Format** — L p
- **Example** — LPRINT "L 1"
- **Parameter range** — −5 to 5
- **Default value** — "L 0"
- **Related commands** — D, I, C, E, G, K, T, B, ^LT, ^LN
- **Explanation** — This command enables the type of line to be drawn to be set with the straight line commands D and I, the circle commands C, E and G, the segment line command K, and the hatching command T.

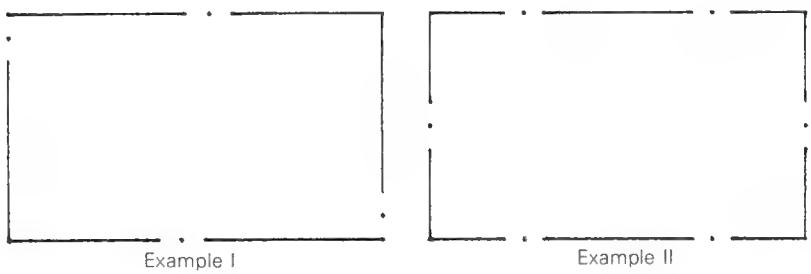
  The following 11 line types may be selected with p = −5 to 5.



The start and end positions of the line differ according to when a positive or negative value is specified.



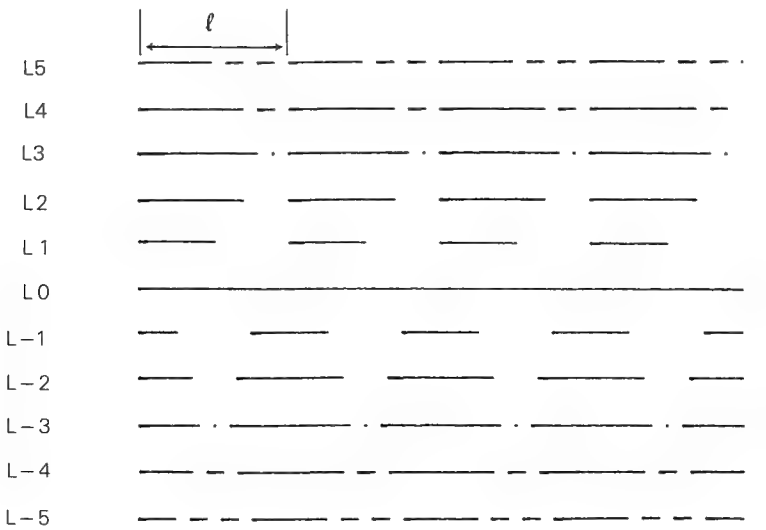
If, for example, when a rectangle is to be drawn with single dot-dash lines, specification of the positive parameter p = 5 results in the end positions of the lines being non-uniform as in Example 1 according to the line lengths. If the negative parameter p = −5 is specified the start and end points of the line are uniform and in accordance with the line length as shown in Example 2. In such cases pitch may differ slightly; however, when plotting circles and hatching with dotted and single dot-dash lines, etc., the uniformity of start and end points produces a more attractive result.



If a parameter outside the range −5 to 5 is specified, it is ignored and the previous value remains valid.
The initial value of p = 0 produces a solid line.
The ''B'' command (dotted line pitch specification) may be specified anywhere in the program.
When a line type is set with this command it is valid until power is switched OFF or the L or LT command is used to set a new parameter.

"B" COMMAND Line Scale

- **Function** — Sets pitch for dotted lines, single dot-dash lines, and double dot-dash lines.
- **Format** — B ℓ
- **Example** — LPRINT "B 50"
- **Parameter range** — 0 to 16383
- **Default value** — "B 80"
- **Related commands** — L, ^LT, ^LN
- **Explanation** — Sets pitch for dotted lines, single dot-dash lines, and double dot-dash lines.



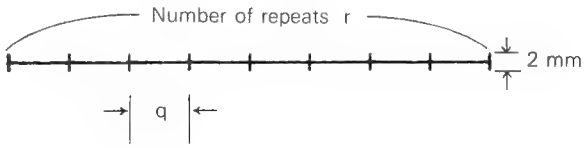
As L is an integer value where $0 < 1 \leqq 16383$, specification of a parameter larger than the line length will result in the plotter drawing a solid line.
When a negtive parameter is specified with the L command, pitch is adjusted so that an integer value number of patterns is drawn in the plotting area. This will result in dimensions which differ slightly from the specifications.
The default value is $\ell = 80$.
When pitch is set with this command, it is valid until power is switched OFF or the B or ^LN command is used to set a new pitch.

"X" COMMAND Axis

- **Function** — Draws a coordinate axis and scale parallel to the x or y axis.
- **Format** — Xp, q, r
- **Example** — LPRINT "X 1, 100, 15"
- **Parameter range** — p: 0, 1
  q: −16383 to +16383
  r: 1 to 16383

● Explanation

Draws from the current pen position.
The y coordinate axis is specified with p=0 and the x coordinate axis, with p=1. If parameters other than 0 or 1 are specified an error occurs.
q is used to specify the intervals on the scale and is an integer value between −16383 and +16383. r specifies the number of times the scale is to be drawn and is an integer value between 1 and 16383. Both q and r are rounded up or down to the nearest integer. When a negative value is specified for q the coordinate axis is drawn in the negative direction (when p=1 the scale is drawn downwards from the current pen position, when p=0 the scale is drawn left wards from the current pen position).



"P" COMMAND Print

● Function

Draws ASCII code characters and symbols.

● Format

Pc1, c2, ... cn

● Example

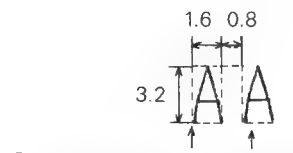
```
LPRINT "P ABCD"
LPRINT "P"; CHR$ (65); CHR$ (66); CHR$ (67); CHR$ (68);
```

● Related commands

Character size: S, ^SI, ^SR
Character slant: ^SL
Character type: ^SA, ^SS, ^CS, ^CA
Direction, Q, ^DR, ^DI

● Explanation

Draws the content of the parameters (characters, symbols, or variables) following "P". The size of the characters and symbols drawn may be altered with the S command. The characters and symbols are drawn relative to the current pen position and the pen position is moved one space to the right after each character or symbol is drawn.



Current pen position (drawing base point)

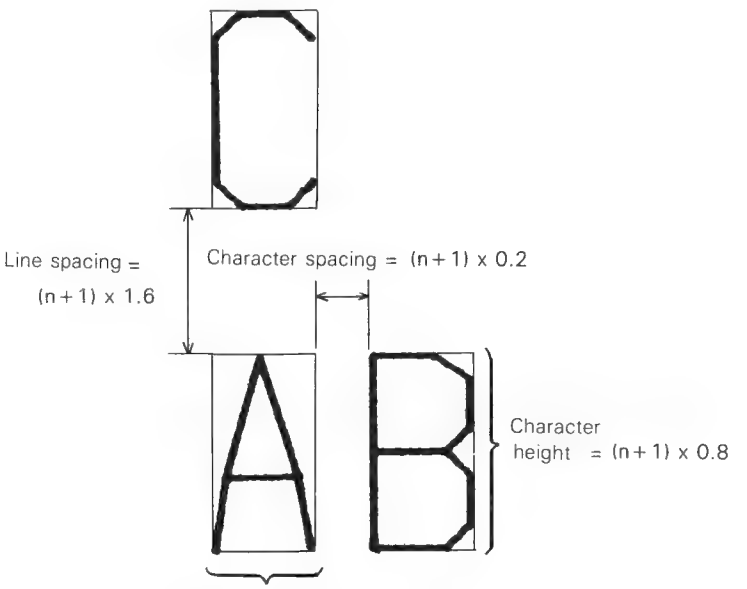
Position after one character or symbol is drawn (when S=3 is the default value)

Use character codes when drawing character patterns not included on the keyboard.

"S" COMMAND Alpha Scale

- **Function** — Sets character size.
- **Format** — Sn
- **Example** — LPRINT "S 9"
- **Parameter range** — 0 to 127
- **Default value** — "S 3"
- **Related commands** — ^LB, ^CP
- **Explanation**

Sets the size of characters to be drawn with the "P" and "N" commands. The parameter n must be between 0 and 127, and as shown in the following table, when character or symbol size and the character interval n=0, character size is n+1.
When a parameter outside the range is specified this command is ignored and the previously specified S command is valid.



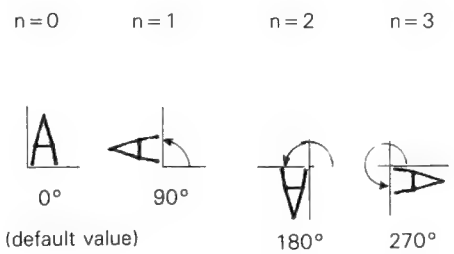
When n=0 Character height : (0 + 1) x 0.8 = 0.8 mm
Character width : (0 + 1) x 0.4 = 0.4 mm
Character spacing : (0 + 1) x 0.2 = 0.2 mm
Line spacing : (0 + 1) x 1.6 = 1.6 mm

The default value is n=3.
When size is set with this command, it is valid until it is set again or power is switched OFF.

"Q" COMMAND Alpa Rotate

- **Function** — Sets the character drawing angle.
- **Format** — Qn
- **Example** — LPRINT "Q 1"
- **Parameter range** — 0 to 3
- **Default value** — "Q 0"
- **Related commands** — ^DR, ^DI
- **Explanation**

Sets the drawing angle for characters drawn with the "P" and "N" commands. The parameter n must be an integer between 0 and 3. If a value outside this range is specified it is ignored and the previously specified angle remains valid. The initial value is n=0.
Drawing angles for character are as follows.

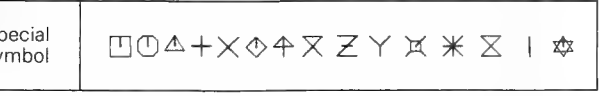


When the drawing angle is set with this command it is valid until it is set again or power is switched OFF.

"N" COMMAND Mark

- **Function** — Draws special symbols.
- **Format** — Nn
- **Example** — LPRINT "N 1"
- **Parameter range** — 1 to 15
- **Related commands** — S, ^SI, ^SR
- **Explanation**

The parameters n=1 to 15 are used to draw the special symbols in the table below centered on the current pen position.
After drawing is completed, the pen carriage does not move to the next position as is the case when ordinary characters are drawn.
Only one parameter may be specified. Symbol size is specified with the S command.

n	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Special symbol	

*The symbols corresponding to the value of n (1 to 15) differ from the DXY-800.

"J" COMMAND Pen Change

- **Function** — Specifies pen select
- **Format** — Jn
- **Example** — LPRINT "J 3"
- **Parameter range** — 0 to 8
- **Default value** — "J 1"
- **Related commands** — ^SP
- **Explanation** — Returns the current pen to its pen clip, replaces it with a different pen, and then returns to the position prior to execution of the command. When the current pen is specified the pen carriage does not move. An error occurs if a parameter other than 0 to 8 is specified. As the default value is n=1, No.1 pen is automatically selected unless this command is executed. Specification of the parameter J 0 has the same effect as pressing the HOME key.
The J command is valid after the next movement command is specified. If the next command specifies movement in the pen-up status the pen carriage moves directly to the specified position after pen selection. If the next command specifies movement in the pen-down status the pen carriage moves to the position at the time the J command was specified and then moves in the pen-down status.

"C" COMMAND Circle

- **Function** — Draws circles and arcs centered on the specified coordinates.
- **Format** — Cx, y, r, θ1, θ2 (, θd)
- **Example** — LPRINT "C500, 1500, 300, 0, 360"
[draws a circle of radius 300 centered on the coordinate (500, 1500)]
- **Parameter range** — x, y, r, : −16383 to +16383
θ1, θ2 : −32767° to +32767°
θd : 1° to 179.9999°
- **Related commands** — L, B, ^LT

● Explanation

Draws circles and arcs centered on the specified coordinates (x, y). Parameter r is the radius of the circle or arc. x, y, and r must be within the range −16383 to+16383. $\theta 1$ is the start angle and $\theta 2$ is the completion angle, and $\theta 1$ and $\theta 2$ must be in the range −32767°to+32737°. The "+" sign may be omitted.
When $\theta 1 < \theta 2$ the circle or arc is drawn counterclockwise, and when $\theta 1 > \theta 2$ the circle or arc is drawn clockwise.
Specification of the parameter θd enables drawing of a polygon. θd must be in the range1°to179.9999°, so that specification of θd as 60° will result in drawing of a hexagon, and specification as45° will result in drawing of an octagon.
When θd is omitted the default value is 5°. When r > 800, or when a large circle or arc is drawn, specification of θd as 5° or less permits drawing of a circle with higher resolution.
Specified θd is adjusted into positive numbers to divide θc equally.
When θd is omitted with circles having a radius of 80mm or less, θd is automatically set to a large value in order to reduce drawing time.

"E" COMMAND Relative Circle

● Function

Draws circles and arcs starting from the current pen position.

● Format

Er, $\theta 1$, $\theta 2$, (, θd)

● Example

LPRINT "E 200, 180, 360"
(draws a circle of radius 200 from the current pen position)

● Parameter range

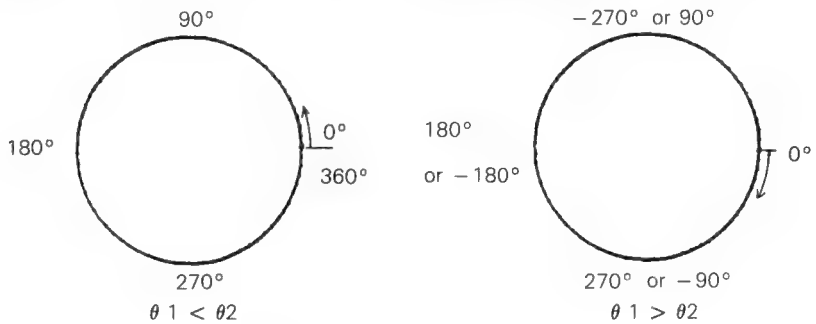
r : −16383 to +16383
$\theta 1$, $\theta 2$: −32767° to +32767°
θd : 1° to 179.9999°

● Related commands

L, B,^ LT

● Explanation

As with the C and G commands, the E command draws circles and arcs. They are drawn starting from the current pen position. This enables drawing of a number of joined circle or arcs. Parameter r is the radius of the circle or arc and must be within the range −16383 to +16383.
$\theta 1$ is the start angle and $\theta 2$ is the completion angle, and $\theta 1$ and $\theta 2$ must be in the range −32767° to +32767°. The "+" sign may be omitted.
When $\theta 1 < \theta 2$ the circle or arc is drawn counterclockwise, and when $\theta 1 > \theta 2$ the circle or arc is drawn clockwise. Specification of the parameter θd enables drawing of a polygon. θd must be in the range 1° to 179.9999°, so that specification of θd as 60° will result in drawing of a hexagon, and specification as 45° will result in drawing of an octagon.
When θd is omitted the default value is 5°. When r > 800, or when a large circle or arc is drawn, specification of θd as 5° or less permits drawing of a circle with higher resolution.
Specified θd is adjusted into positive numbers to divide θc equally.
When θd is omitted with circles having a radius of 80mm or less, θd is automatically set to a large value in order to reduce drawing time



"A" COMMAND Circle Center

- **Function**

  Sets the center coordinates for circles and arcs drawn with the G and K commands.

- **Format**

  Ax, y

- **Example**

  LPRINT "A 1500, 1500"

- **Paramter range**

  −16383 to +16383.

- **Related commands**

  G, K

- **Explanation**

  Sets the center coordinates for circles and arcs using the x and y parameters. All coordinates are absolute coordinates, and parameters must be in the range −16383 to +16383. The "+" sign may be omitted. If a parameter outside the range is specified, it is ignored and the previous value set with the A command remains valid.
  When coordinates are set with this command they are valid until power is switched OFF or they are set again. With the use of the G and K commands in particular, specification of parameters exceeding the effective plotting area may be result in nothing being drawn at all.

"G" COMMAND A + Circle

- **Function**

  Draws a circle or arc centered on the coordinates set with the A command.

- **Format**

  G r, θ1, θ2, (, θd)

- **Example**

  LPRINT "G 500, 0, 360" (draws a circle of radius 500)

- **Parameter range**

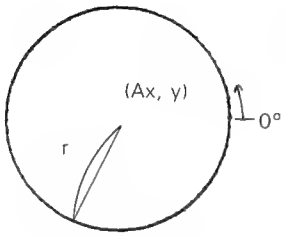
  r : −16383 to +16383
  θ1, θ2 : −32767° to +32767°
  θd : 1° to 179.9999°

- **Related commands**

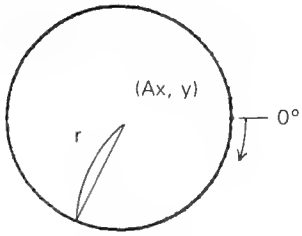
  A, L, B, ^LT

- **Explanation**

  Parameter r is used to specify the radius of the circle and must be in the range −16383 to +16383. If a negative parameter is specified the drawing start position (0°) is set at the same position as when a positive parameter is specified (180°).
  θ1 is the start angle and θ2 is the completion angle, and θ1 and θ2 must be in the range −32767° to +32767°. The "+" sign may be omitted.
  When θ1 < θ2 the circle or arc is drawn counterclockwise, and when θ1 > θ2 the circle or arc is drawn clockwise. Specification of the parameter θd enables drawing of a polygon. θd must be in the range 1° to 179.9999°, so that specification of θ d as 60° will result in drawing of a hexagon, and specification as 45° will result in drawing of an octagon.
  When θd is omitted the default value is 5°. When r > 800, or when a large circle or arc is drawn, specification of θd as 5° or less permits drawing of a circle with higher resolution.
  Specified θd is adjusted into positive numbers to divide θc equally.
  When θd is omitted with circles having a radius of 80mm or less, θd is automatically set to a large value in order to reduce drawing time.
  This command is ignored when a parameter exceeding the relevant range is specified.



$\theta 1 < \theta 2$



$\theta 1 > \theta 2$

"K" COMMAND A + %

- **Function**

Draws segment and indication lines for circles.

- **Format**

Kn, $\ell 1$, $\ell 2$

- **Example**

LPRINT "K 20, 200, 0"
(draws segment lines extending to a distance of 200 from the center of the circle and at the 20% position)

- **Parameter range**

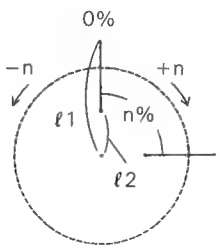
n : −9101 to +9101
$\ell 1, \ell 2$: −16383 to 16383

- **Related commands**

A, G, L, B, ^LT

- **Explanation**

Draws segment and indication lines for circles and arcs drawn with the A and G commands. This command is only valid when the A command has been executed.
Parameter n specifies the angle for the segment line, the top of the circle being 0% and one revolution being equivalent to the 100%(360°). Specification must be with the range −9101% to +9101% The "+" sign may be omitted.
Specification of parameter n as a positive value results in the lines being drawn clockwise, and specification as a negative value results in the lines being drawn counterclockwise, from the outside to the inside of the circle and of the specified length.
Parameter $\ell 1$ specifies the distance of the end of the segment and indication lines from the center and must be in the range −16383 to +16383.



$\ell 2$ specifies the distance from the center of the cirlcle at which the segmentation or indication line begins, $\ell 1$ specifies the distance from the center of the circle to the end of the line. These lines are drawn in accordance with the value $\ell 1$-$\ell 2$.
With $\ell 1$=circle radius and $\ell 2$=0, segmentation lines are drawn from the center to the periphery of the circle. If $\ell 1$ is specified as being larger than the circle radius, and $0 < \ell 2 <$ circle radius, indication lines are drawn from inside to outside the circle.

ℓ1 and ℓ2 may be specified as negative values. In such cases, drawing is from the 180° position as with a positive value. For example, when a negative value is specified for a circle of radius 500 drawn with the A command, the following is drawn.

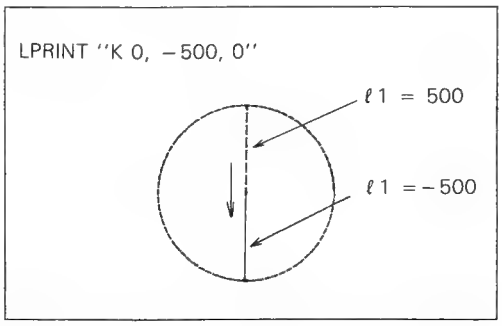


Fig.1

ℓ1 is drawn starting with a position of n+50 (270°), which is 180° from n=0 (90°).

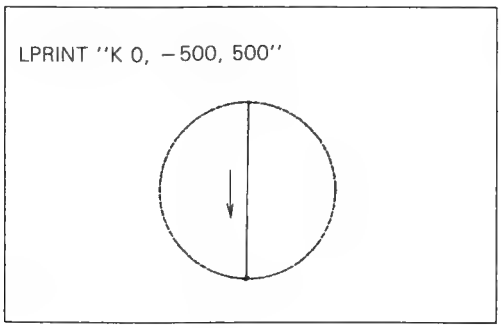


Fig.2

The drawing start position is the same as in Fig.1.
As ℓ2 is specified as 500 the value ℓ1-ℓ2 (ie. the length of the line) is 1000.

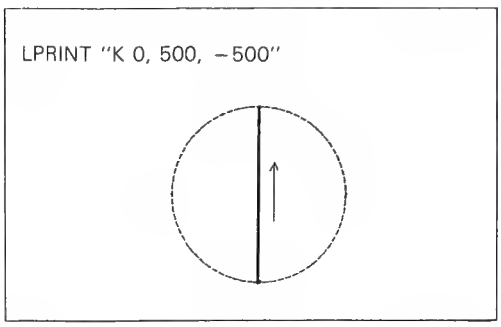
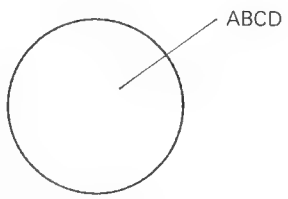


Fig.3

In Fig.3 a line of length 1000(ℓ1-ℓ2) is drawn from the 0% drawing start position. If ℓ1 is specified as being less than ℓ2, and indication line is drawn from inside to outside the circle. This is used to draw pie graphs, the characters explaining the graph then being drawn with the use of the P command.

```
10 LPRINT "K 15, 700, 300"
11 LPRINT "P ABCD"
12 LPRINT "H"
```



Example

"T" COMMAND Hatching

- **Function**

  Draws hatching and rectangles.

- **Format**

  Tn, x, y, d, t

- **Example**

  LPRINT "T3, 400, 200, 20, 2"
  (draws a 400x200 rectangle and hatches it with 45°
  lines spaced at intervals of 20)

- **Parameter range**

  n : 0 to 3
  x, y, d : −16383 to +16383
  t : 1 to 4

- **Related commands**

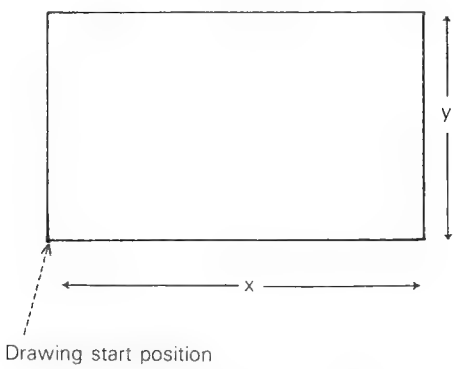
  L, B, ^LT

- **Explanation**

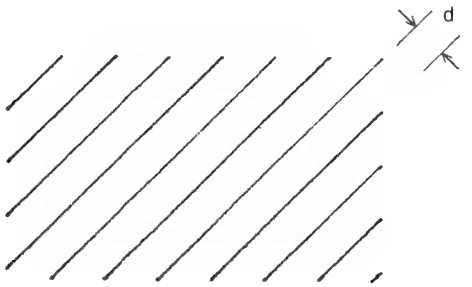
  Parameter n must be in the range 0 to 3, and decimal fractions are rounded up or down to the nearest integer.
  These values are explained below.

  n = 1: Hatching only
  n = 2: Rectangle only
  n = 3: Hatched rectangle
  n = 0: Hatched rectangle

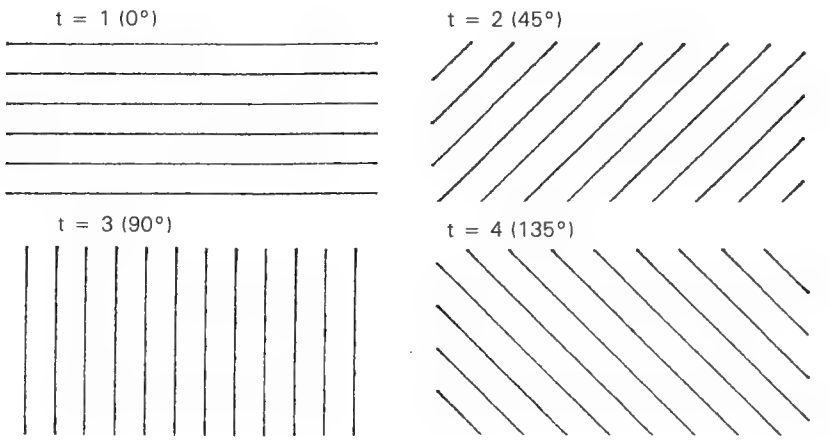
  When parameters x and y specify a rectangle they also specify the lengths in the x and y directions of the hatching area.



Parameter d specifies the intervals between hatching lines and must be in the range −16383 to +16383.
When only a rectangle is drawn (ie. n = 2), this parameter must still be entered as a dummy.

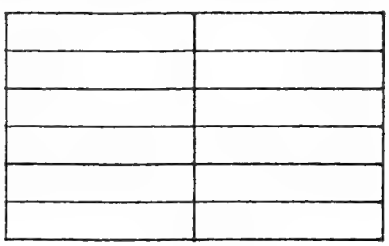


The hatching angle is specified as 0°, 45°, 90°, or 135° with the parameter t values 1, 2, 3, or 4. Decimal fractions are rounded up or down to the nearest integer. If a value other than one of these four is specified the T command is ignored. When only a rectangle is drawn (ie. n = 2), a value of 1 ~ 4 must still be entered as a dummy.



As well as hatching within a specified area, use of the hatching interval in combination with t = 1 or t = 3 permits drawing of tables as shown below.

```
LPRINT "T3,500,300,250,3"
LPRINT "T1,500,300,50,1"
```



"^" COMMAND

The DXY-880 may be used by calling RD-GL commands from the DXY mode. For example, the RD-GL scaling command may be called with the remainder of processing being performed with the DXY commands.

● Function

RD-GL commands are called in the DXY mode by entering "^" followed by the RD-GL command.
Note : DXY commands cannot be called from the RD-GL mode.

● Format

^[RD-GL command] [parameter] ... (,[parameter]) [terminator(;)]

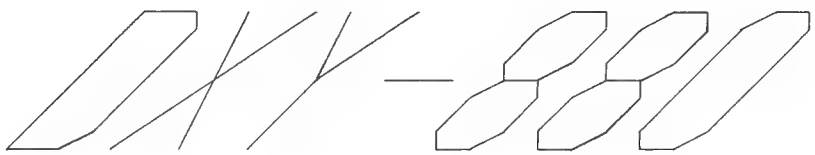
> As input following "^" differs depending upon the RD-GL command to be called, see the section on the RD-GL commands for details.

● Example

LPRINT "^PA 1000, 1000;"

Plotting example
Using the RD-GL SL command to draw slanted characters.

```
10 REM *** "^"Command ***
20 LPRINT "^SL1;"
30 LPRINT "S50"
40 LPRINT "PDXY-880"
50 LPRINT "^SL;"
60 LPRINT "S3"
70 LPRINT "H"
80 END
```



5

RD-GL COMMANDS

RD-GL (Roland DG Graphic Language) is a high performance graphic language that has a compatibility with other graphic languages widely used so far.

In the DXY commands, all the detail settings for the plotter, such as coordinates, plotting area and pen up/down, are included, which eliminates the need of detailed setting by the user, and most commands are independent from others and provide easy plotting.

Added with powerful functions such as scaling and windowing, RD-GL is a graphic language with a high level of flexibility and allows each command to be set in detail to each action of the plotter. DXY-880 has a function to call any RD-GL command from DXY mode as required, combining the advantages of DXY mode with the high-performance graphic functions of RD-GL mode.

RD-GL has the following features and functions

- Features of the commands
  RD-GL allows each command to be set for individual operation of the plotter, providing close drawing control

- Scale function
  In addition to the inherent coordinate system of the plotter (15,200 x 10,800 for A3 standard setting), the RD-GL permits a user coordinate system that can be freely set by the user, providing easy enlargement or reduction of patterns by setting scaling points P1 and P2 to link both coordinate systems.

- Window function
  Like an external landscape viewed through a window frame, drawing can be made within a framed size of window.

- Digitize function
  Use of an RD-GL command of which the first character is "0" allows the plotter to be set ready for transmitting a specified status to the computer.
  For example, the OA command allows the plotter to send back the pen position coordinates on the plotter to the computer, which permits the computer to read the coordinates by using a program statement of "INPUT #1,". This allows the plotter to be used as a digitizer to read the pen coordinates manually set by the position switch.

Note

The digitize function can be used only when the plotter is connected serially (RS-232C).
In addition to the above, RD-GL has many valuable functions and features which will be described in paragraphs for individual commands.

*In the description of RD-GL commands, a command which is written using "LPRINT" in the example can also be executed in serial (RS-232C) connection by replacing it with "PRINT #1,", however, one which is written using "PRINT #1," in the description cannot be used with parallel (Centronics) connection.
When using with "PRINT #1,", use OPEN statement to open file before executing the command.

*To set the plotter to RD-GL mode, turn ON DIP switch-1 No.9 before turning ON the power switch.

INITIALIZATION COMMANDS

DF
IN

"DF" COMMAND The Default Command

● Function

DF commands set the plotter to the default status.

● Format

DF terminator

● Example

LPRINT "DF;"

● Description

Sets the character size and slant to the default status (see Table 1) but the position of scaling points of P1 and P2 remain unchanged.
Since no parameter is used, the DF command with any parameter will cause an error and will not be executed.

Table 1 default status

Function	Equivalent command	Conditions
Plotting mode	PA;	Absolute coordinates
Printing direction	DR;	Right horizontal
Line type	LT;	Solid line
Line pattern length	LT;	4% of diagonal line of P1 and P2
Input Window	IW;	Mechanical limit of plotter
Character size	SR;	Width = 0.5% of (P2x-P1x) Height = 1% of (P2y-P1y)
Symbol mode	SM;	Off
Scale length	TL;	x scale + 0.5% of (P2x-P1x) y scale = 0.5% of (P2y-P1y)
Standard character set	CS;	Value set by the DIP switch
Alternate character set	CA;	Value set by the DIP switch
Character set	SS;	Standard character set
Character slant	SL;	0°
Digitize mode	DC;	Cleared
Scaling	SC;	Not scaled
Pen speed	VS;	200 mm/s
Label terminator	DT CHR$(03);	ETX(CHR $(03))

"IN" COMMAND The Initialize Command

● Function

IN commands set the plotter to the same initial status as the default status.

● Format

IN terminator

● Example

LPRINT "IN;"

● Description

Performs the following setting in addition to the default status by the DF command.
- Pen up (PU;)
- Sets to the default values (IP;)
- Clears an error and sets the third bit of the status byte
- Reads the position of the paper size switch and initializes the scaling points and window.

Since no parameter is used, the IN command with any parameter will cause an error and will not be executed.
The maximum values of the scaling points and window are initialized as shown in the Table below by the setting of DIP switch (1)-7, 8 and 9 when the power is switched ON.

SW-1			PAPER SIZE	PAPER STAN-DARD	COMMAND MODE	MAX P2 POSITION	
7	8	9				P2x	P2y
■	■	■	A3(420x297mm)	ISO	DXY	3800	2700
□	■	■	A4(297x210mm)	ISO	DXY	2700	1920
■	□	■	B (17' x 11')	ANSI	DXY	3800	2580
□	□	■	A (11' x 8.5')	ANSI	DXY	2580	1980
■	■	□	A3(420x297mm)	ISO	RD-GL	15200	10800
□	■	□	A4(297x210mm)	ISO	RD-GL	10800	7680
■	□	□	B (17' x 11')	ANSI	RD-GL	15200	10320
□	□	□	A (11' x 8.5')	ANSI	RD-GL	10320	7920

*P1x, P1y = 0, 0

PEN CONTROL COMMANDS

PU, PD
PA
PR
LT
SP
VS

"PU" and "PD" COMMANDS The Pen Up/Down Commands

● Function

Pen up command PU and pen down command PD raise and lower the pen conditions.
With parameters, the pen moves to the point designated by the parameters in a specified pen condition. This allows the pen to draw lines or move to the pen up condition.

● Format

PU (terminator)
PD (terminator)
PU X, Y (, -----) (terminator)
PD X, Y (, -----) (terminator)

● Example

```
LPRINT "PU 500, 500;"
LPRINT "PD 1500, 700, 1300, 500;"
```

● Parameter range

−32767 to 32767

● Description

Without parameters, the pen moves only up or down. With parameters, the pen moves to the designated point, as the absolute coordinates if the PA command has been entered or as the relative coordinates if the PR command has been entered, in that pen condition.
However, when a point out of the window is designated, the pen moves to the boundary of the window, then moves up.
Two parameters of X and Y make a set, and any number of sets can be used.

"PA" COMMAND The Plot Absolute Command

● Function

PA command sets an absolute coordinate system. Specified by the X and Y coordinates. The pen moves to the point.

● Format

PA (pen control) X1, Y1 (pen control) (, X2, Y2, ...) (terminator)
PA (terminator)

● Example

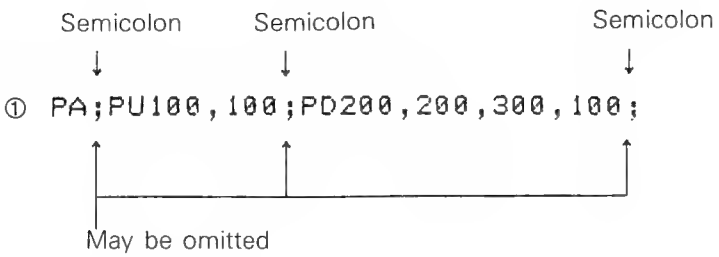
```
LPRINT "PA 50, 40, 300, 2000;"
LPRINT "PA;"
LPRINT "PD;PA 50, 40; PU 200, 200;"
```

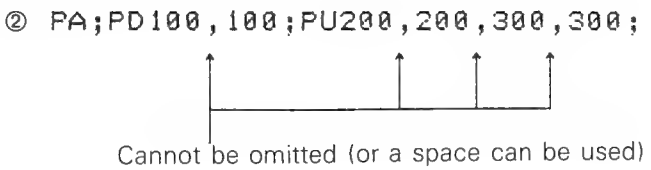
● Parameter range

−32767 to 32767

● Description

The PA command with no parameters sets an absolute coordinate system. This makes parameters of subsequent PD and/or PU commands determined as absolute coordinates. The PA command with parameters sets absolute coordinates and, at the same time, moves the pen to the point designated by the X, Y coordinates. The pen remains in a condition before receiving the PA command. Thus, in a pen up condition, the pen only moves drawing nothing or, in a pen down condition, it draws.
Any number of sets of parameters X and Y can be used, but if an odd number of parameters are used, such as only X or Y, every two parameters from the top will be regarded as a parameter set to plot and the last single parameter will cause an error. The parameter should be within a range of −32767 to 32767, and any parameter out of the range will cause an error.
The PA command is used in combination with the pen control commands PU and PD as shown in Example (1) below. The first PA command indicates that subsequent coordinate values (100, 200, 300) are those of absolute coordinate system, the pen moves from the current position to (100, 100) in a pen up condition, draws a line to (200, 200) then to (300, 100) in a pen down condition. A comma (or a space) is necessary to mark off a coordinate value. A semicolon (;) is a terminator where a command statement ends.



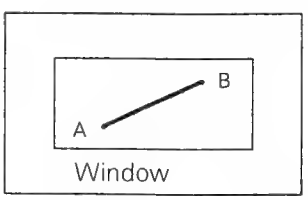


○ Relationship between window and PA command

Window is set to a specified paper size as a default value. The pen moves within a currently defined window to draw lines. Pen movement is classified into the following four cases in regard to the inside and outside of the window.

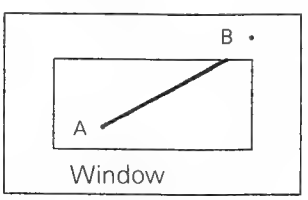
< Current point : A > <Designated point : B>
① From inside window to inside window
② From inside window to outside window
③ From outside window to inside window
④ From outside window to outside window

①



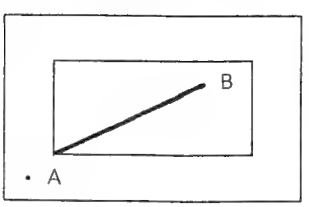
•The pen moves from point A to point B.

②



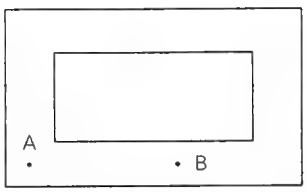
•Moves from point A to point B but stops at the window boundary where the pen goes up.

③



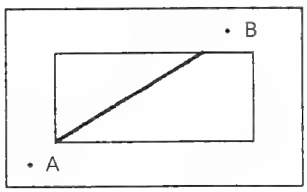
•Moves from point A towards point B up to the window boundary in a pen up condition, then to point B in a designated pen condition.

④ -i)



•The pen will not move if a straight line between points A and B does not cross the window.

④ -ii)



•When a straight line between point A and B crosses the window, the pen moves to a window boundary in a pen up condition, then to the other window boundary in a designated pen condition. The pen stops at this point and goes up.

○ Setting an absolute coordinate system

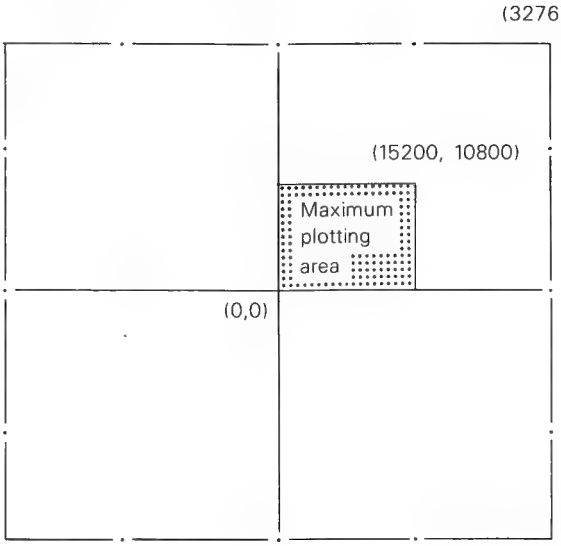
Other than the PA command, either of the following three methods can set an absolute coordinate system.

i. Switching OFF then ON the power.
ii. Execution of the IN command.
iii. Execution of the DF command.

In addition to the absolute coordinate system, there is a relative coordinate system which will be described in detail in the next paragraph for the PR command.
Examples are shown below for thorough understanding of "PA", "SC", "PD", and "PU" commands.
In example (1), the SC command is not used but the coordinate unit is designated by the plotter unit.
In example (2), coordinates are specified using a user coordinate system, between scaling points P1 and P2 is divided into 100 parts.
In example (3), the SC command is used to define 2000 plotter coordinates as unity of the user coordinate, so that a value calculated using sin or cos, a decimal fraction, can be used as it is. This allows a decimal fraction to be used with a unit of 1/2000=0.0005. Note that variables are used to draw a pattern.

Note) The minimum resolution that can be treated by a command is 0.0001.

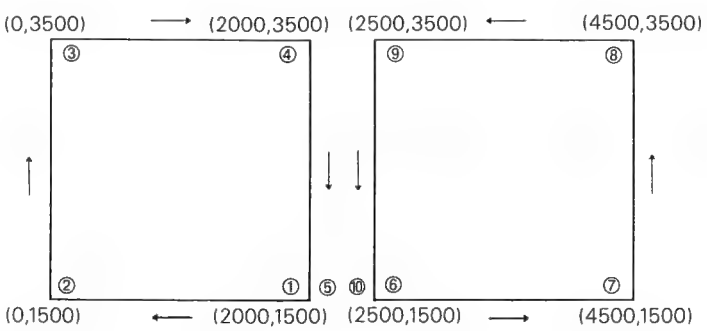
○ Parameter settable area



In practice, no drawing can be made out of the plotting area, however, it can be reduced or enlarged using scaling to be drawn within the plotting area. Any pattern out of the parameter settable area cannot be drawn in the plotting area using any scaling, but causing an error.

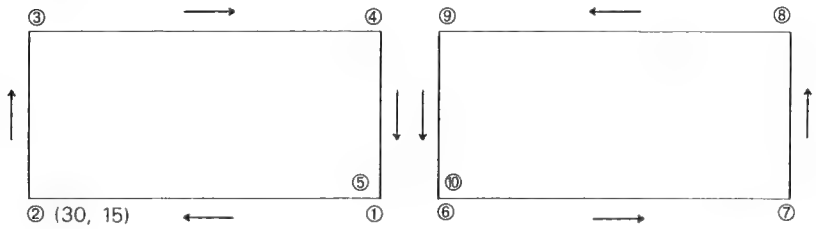
(Example 1)

```
1000 '**** SCALE OFF PLOTTER UNITS ****
1010 LPRINT "IN;SP1;"
1020 LPRINT "PA2000,1500;PD0,1500,0,3500,2000,
     3500,2000,1500;PU2500,1500;"
1030 LPRINT "PA;PD4500,1500,4500,3500,2500,3500,
     2500,1500;PU;"
1040 END
```



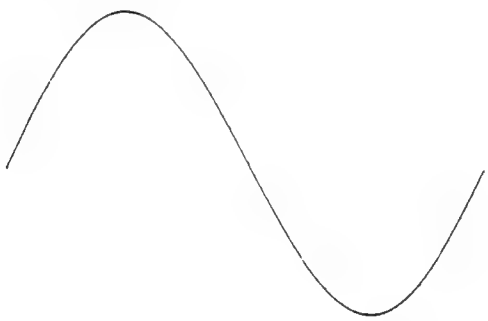
(Example 2)

```
1050 '**** SCALE ON USER UNITS ****
1060 LPRINT "IN;SP1;"
1070 LPRINT "SC0,100,0,100;"
1080 LPRINT "PA30,15;PD0,15,0,35,30,35,30,15;
     PU35,15;"
1090 LPRINT "PA;PD65,15,65,35,35,35,35,15;PU;"
1095 END
```



(Example 3)

```
1000 '**** SCALE ON'& USING VARIABLES ****
1010 LPRINT "IN;IP4000,3000,6000,5000;"
1020 LPRINT "SP2;SC0,1,0,1;"
1030 PI=3.14159
1040 LPRINT "PU;"
1050 FOR I=0 TO 2*PI STEP PI/40
1060   X=I/2
1070   Y=SIN(I)
1080   LPRINT "PA";X;",";Y;"PD;"
1090 NEXT I
1100 LPRINT "PU0,0;"
```



"PR" COMMAND The Plot Relative Command

● Function

PR commands set relative coordinates.
When ΔX and ΔY are specified, the pen is moved by the difference specified by ΔX and ΔY from the current position.

● Format

PR (pen control) (ΔX1, ΔY1) (pen control) (ΔX2, ΔY2) (terminator)
PR (terminator)

● Example

```
LPRINT "PR 10, 5, −30, 7;"
LPRINT "PR;PU 10, 5;PD−30, 7;"
LPRINT "PR;"
```

● Parameter range

−32767 to 32767

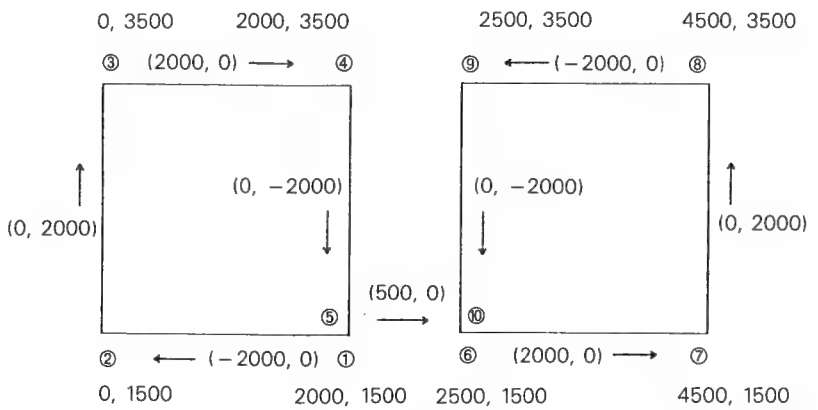
● Description

The PR command with no parameters is to set a relative coordinate system. This makes parameters of subsequent PD and/or PU commands determined as relative coordinates. The PR command with parameters sets relative coordinates and, at the same time, moves the pen by a designated difference from the current position. The new position is set to as a new original point for the next movement. The parameter conditions are same as of the PA command. If an odd number of parameters are used, every two parameters from the top will be regarded as a parameter set and the last single parameter will cause an error. The parameter range and conditions and relation to window are same as the PA command.

After switching ON the power or execution of either IN or DF command is the same as after the execution of the PA command. Therefore, it is necessary to execute the PR command to set X and Y values to relative coordinates. The example shown below uses the PR command to draw a rectangular pattern, same as drawn in the PA command example. Each point is given with its X and Y differential coordinates in the relative coordinate system. Compare them with the absolute coordinate values in ( ).

(Example)

```
1300 REM ****  "PR"Command  ****
1310 LPRINT  "IN;SP1;"
1320 LPRINT  "PA2000,1500;PD;PR-2000,0,0,2000,
     2000,0,0,-2000;PU500,0;"
1330 LPRINT  "PD2000,0,0,2000,-2000,0,0,-2000;PU;"
1340 END
```



"LT" COMMAND The Line Type Command

● Function

LT command designates a type of dotted-line and its pitch length.

● Format

LT pattern number (, pitch length) (terminator)
LT (terminator)

● Example

LPRINT "LT 1, 7;"
LPRINT "LT ;"

● Parameter range

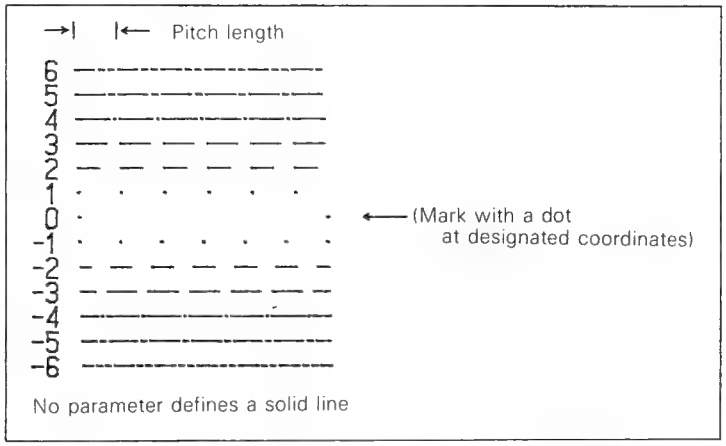
Pattern number: −6 to +6
Pitch length : 0 to 127%

● **Default value**

"LT −1, 1.5;"

● **Description**

Type of dotted-line varies with the pattern number as follows:



Pattern number must be within a range of −6 to 6. (−7 < pattern number < 7)
A pattern number out of the range results in one of the following.

1. 128 or more ← Error
2. 7 to 127 ← Ignored (No change in line type)
3. Greater than −128 and smaller than −7 ← Ignored (No change in line type)
4. −128 or less ← Error

The pitch length parameter is effective when the pattern number is within ±127. This parameter represents the pitch length in percentage of the diagonal line between scaling points P1 and P2. When no pitch length is designated, it is set to 1.5%. When the pattern number is negative, the pitch length is automatically adjusted so that an integer number of patterns are put into the designated area.

A. When the pattern number is positive.

```
LPRINT "LT5"
LPRINT "PR;PD2000,0,0,1000,-2000,0,0,-1000;PU;"
```

B. When the pattern number is negative.

```
LPRINT "LT-5"
LPRINT "PR;PD2000,0,0,1000,-2000,0,0,-1000;PU;"
```

"SP" COMMAND The Select Pen Command

- **Function** — SP command selects or stores one of the eight pens.
- **Format** — SP pen number (terminator)
  SP (terminator)
- **Example** — LPRINT "SP 1;"
- **Parameter range** — 0 to 8
- **Default value** — "SP 1;"
- **Description** — Selects one of No.1 to No.8 pens according to the parameter. The SP command with no parameter or 0 returns a pen to the pen stock and moves to the standby position. After a pen is taken up, the system returns to the position before executing the SP command. If a same pen number as on the pen carriage is designated, the pen carriage will not move. This command allows different colors or line widths to be selectively used in a plotting run. A pen on the pen carriage can be returned to the pen clip by using the SP command with no parameter. The No.1 pen is selected after executing the SP command with a parameter of 0 or no parameter or just after turning ON the plotter power.

"VS" COMMAND The Velocity Select Command

- **Function** — Sets the pen speed during plotting.
- **Format** — VS pen speed (terminator)
  VS (terminator)
- **Example** — LPRINT "VS 10;"
  LPRINT"VS;"
- **Parameter range** — 2 to 25
- **Default value** — "VS 20;"

● Description

The VS command with no parameter set the pen speed to the initial value, 20 cm/sec. the VS command with a parameter sets the speed every 1 cm/sec. The parameter range is 2 to 25. A parameter of less than 2 sets the speed to 2 cm/sec., or more than 26 sets to 20 cm/sec.

OHP mode is conveniently used for OHP film.
OHP mode can be set, when the power is switched ON, by pressing the FAST key or the V key simultaneously. In OHP mode, the plotting speed can be set up to 8 cm/sec. using the VS command.

CHARACTER COMMANDS

LB
SR
SI
SL
DR
DI
CP
CS
CA
SS
SA
DT
UC

"LB" COMMAND The Label Command

● Function

Prints a character string until a label terminator defined by the DT command, using a currently designated character set.

● Format

LB character string (label terminator)

● Example

```
LPRINT "LB Roland DG";CHR$(3)
LPRINT "LB";A;B;CHR$(3)
```

● Parameter range

DT, CS, SS, CA, SA, DI, DR, SI, SR, SL

● Description

The LB command sets the plotter to print mode. In print mode, all inputs are interpreted as character strings until a label terminator is received. The label terminator is initially set to code ETX(03), which can be changed using the DT command.
Character sets that are used in printing with the LB command include those designated by the CS, SS, CA, or SA command, ASCII code 32 to 127. The direction of character string is designated by the DI or DR command, the size by the SI or SR command, and the slant by the SL command.
In the printing by the LB command, a current pen position is the left lower corner of the first character.
Therefore, before executing of the LB command, the pen should be moved to the location where labeling is to begin using one of the plot commands (PA, PR, or CP) or by front-panel controls.
After that, when carriage return CR (CHR$(13)) is received, the pen returns to the lower left corner of the first character but no line feed is made. To make both carriage return and line feed, both carriage return CR (CHR$(13)) and line feed LF (CHR$(10)) should be entered. Refer to the example in the paragraph for the CP command.
As special codes, there are back space (CHR$(08)) and vertical tab VT (CHR$(11)). Variables can be, of course, used as character strings. Two or more consecutive variables are plotted with no blank between variables by using a semicolon as a delimiter between variables. When a comma is used as a delimiter, variables are printed at the right end within a specified space (depending on computer) as shown below.

When A = 11

```
"LB";A,2*A,3*A;CHR$(3)
```

is executed:

```
11              22              33
```

```
"LB";A;2*A;3*A;CHR$(3)
```

is executed:

```
11  22  33
```

Note) A A variable is treated including the sign, and a positive variable gives a space before it.

When A = 11

```
"LBXYZ";A;CHR$(3)
```

is executed:

```
 XYZ 11
```

When A = −11

```
"LBXYZ";A;CHR$(3)
```

is executed:

```
XYZ-11
```

"SR" COMMAND The Relative Character Size Command

- **Function**: Designates size of characters or symbols in percentage (%) to the distance in X- and Y- directions between scaling point P1 and P2.
- **Format**:
  SR character width, height (terminator)
  SR (terminator)
- **Example**:
  LPRINT "SR 2.5, 3.5;"
  LPRINT "SR;"
- **Default value**: "SR 0.5, 1.0;"
- **Related commands**: IP, SC, IW
- **Description**: The SR command is to designate relative character size in which character size varies with scaling ratio. The command with no parameters sets the default status, width to 0.5 and height to 1.0. A single or three or more parameters will cause an error and the command will not be executed.

$$\text{Character width} = (P2x - P1x) \times \frac{\text{width parameter}}{100}$$

$$\text{Character height} = (P2y - P1y) \times \frac{\text{height parameter}}{100}$$

"SI" COMMAND The Absolute Character Size Command

- **Function**: Designates size of characters or symbols in centimeter (cm).
- **Format**:
  SI character width, height (terminator)
  SI (terminator)
- **Example**:
  LPRINT "SI 10, 10;"
  LPRINT "SI;"
- **Default value**: "SI 0.19, 0.27;"
- **Description**: The SI command designates absolute character size by two parameters, character width and height. A character size designated by the SI command is unchanged by reduction or enlargement using the IP, SC, or IW command or manual control. The SI command with no parameters sets the width to 0.19 and height to 0.27 as the default status. A single or three or more parameters will cause an error and the characer size will be unchanged.

"SL" COMMAND The Character Slant Command

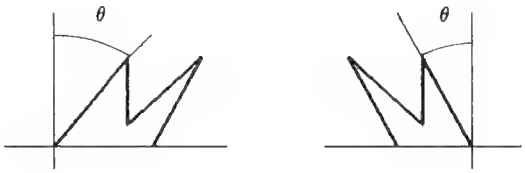
- **Function**: SL command designates slant of printed characters or symbols
- **Format**:
  SL tanθ (terminator)
  SL (terminator)
- **Example**:
  LPRINT "SL 1;"
  LPRINT "SL ;"
- **Default value**: "SL 0 :"

● Related commands

IN, DF

● Description

A parameter designates tanθ to the vertical line as shown. If two or more parameters are used, other parameters than the first one will be ignored. The SL command without parameters defaults to no slant condition. The parameter range is from −127 to +127. However, for easy reading, it is recommended to use a parameter within ±0.4 for default size characters or ±0.8 for enlarged. The SL command remains in effect until IN, DF or new SL command is received.



"DR" COMMAND The Relative Direction Command

● Function

DR command designates print direction in ratios to length in X- and Y-directions between scaling points P1 and P2.

● Format

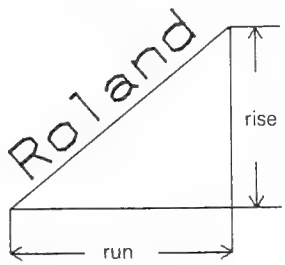
DR run, rise (terminator)
DR (terminator)

● Example

LPRINT "DR 1, 0"
LPRINT "DR;"

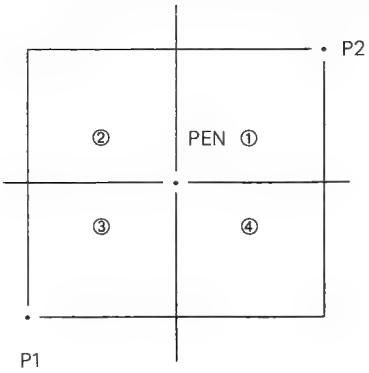
● Default value

DR 1, 0 (horizontal)



● Description

Parameter "run" for the DR command designates a percentage(%) to P2x − P1x and parameter "rise" a percentage(%) to P2y − P1y. Relationship between run and rise is as shown in the figure above. Note that print direction varies with the positions of scaling points P1 and P2. Values of run and rise should be within 0 to ±127. rise = 0 designates horizontal or run = 0 designates vertical direction. If both are zero, an error will be caused.
The DR command with no parameters defaults to the values DR1, 0 (horizontal direction). A single or three or more parameters will cause an error and the command to be ignored.
Sign of parameter is determined according to the quadrant of the print direction, with the current pen position as the original print, as shown in the Figure below.



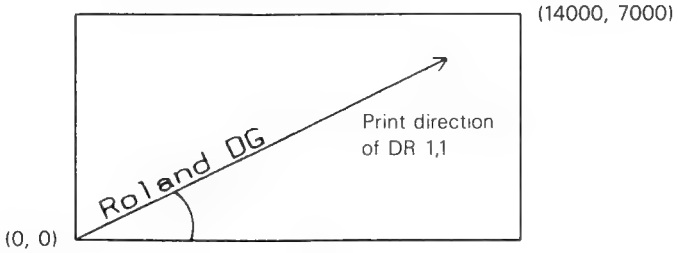
	run	rise
①	+	+
②	−	+
③	−	−
④	+	−

Print direction of a same "DR1, 1" varies with IP setting as follows.

```
12000 REM *** "DR"Command ***
12010 LPRINT "IN;"
12020 LPRINT "DR1,1;"
12030 REM *** exp1. ***
12040 LPRINT "IP0,0,14000,7000;"
12050 LPRINT "PA;PU1000,1000;"
12060 LPRINT "LBRoland DG";CHR$(3)
12070 REM *** exp2. ***
12080 LPRINT "IP0,0,7000,7000;"
12090 LPRINT "PA;PU1000,2000;"
12100 LPRINT "LBRoland DG";CHR$(3)
```

Example 1.)

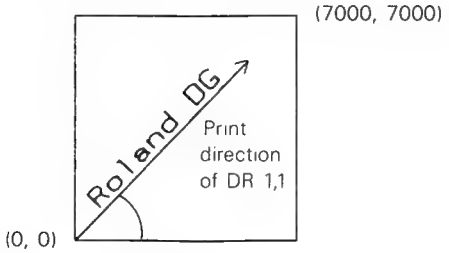
For P1 (0,0) and P2 (14000,7000)



Aspect ratio = 1 : 2

Example 2.)

For P1 (0,0) and P2 (7000,7000)



Aspect ratio = 1 : 1

"DI" COMMAND The Absolute Direction Command

● **Function**

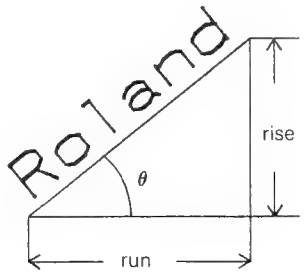
DI command designates print direction.

● **Format**

DI run, rise (terminator)
DI (terminator)

● **Example**

LPRINT "DI 1, 0;"
LPRINT "DI;"



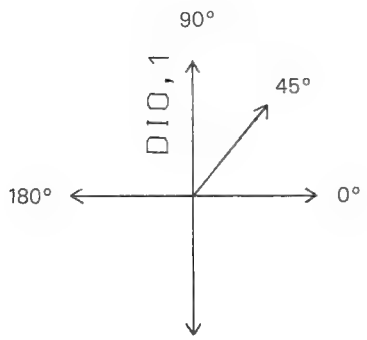
● **Default value**

"DI 1, 0 ;" (horizontal)

● **Description**

The DI command designates an absolute direction, independent of the positions of P1 and P2. Relationship between the two parameters, run and rise, designates a direction as shown in the figure above. Run and rise are values within 0 to ±127, rise = 0 designates horizontal direction and run = 0 vertical direction. If both are zero, an error will be caused. For a known print angle θ, DI cosθ, sinθ can be executed. The DI command with no parameters will default to the values DI 1, 0 (horizontal). If a single or three or more parameters are used, the command will be ignored.

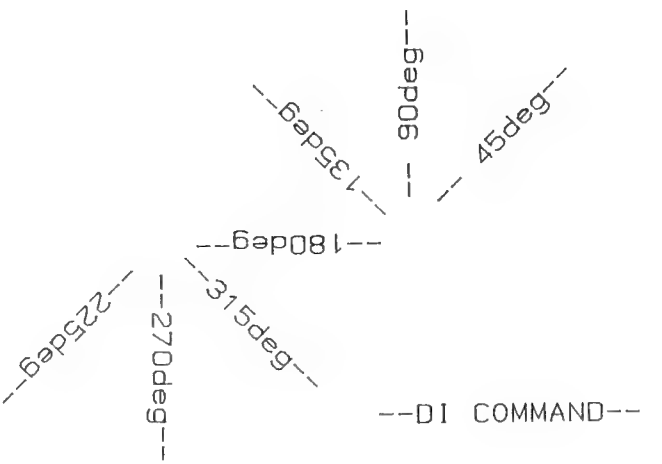
A direction set by the DI command remains in effect until a new DI or DR command is executed or not set to the default value by the IN or DF command. An example of the DI command is shown below.



	run	rise
0°	1	0
45°	1	1
90°	0	1
135°	−1	1
180°	−1	0
225°	−1	−1
270°	0	−1
315°	1	−1

[Example]

```
13000 REM ****  "DI"Command  ****
13010 LPRINT "IN;PA4500,4500;SP2;"
13020 LPRINT "DI1,1;LB   -- 45deg--";CHR$(&HD)
      ;CHR$(&H3)
13030 LPRINT "DI0,1;LB   -- 90deg--";CHR$(&HD)
      ;CHR$(&H3)
13040 LPRINT "DI-1,1;LB   --135deg--";CHR$(&HD)
      ;CHR$(&H3)
13050 LPRINT "DI-1,0;LB   --180deg--   ";CHR$(&H3)
13060 LPRINT "DI-1,-1;LB  --225deg--";CHR$(&HD)
      ;CHR$(&H3)
13070 LPRINT "DI0,-1;LB   --270deg--";CHR$(&HD)
      ;CHR$(&H3)
13080 LPRINT "DI1,-1;LB   --315deg--   ";CHR$(&H3)
13090 LPRINT "DI;LB   --DI  COMMAND--";CHR$(&H3)
```



"CP" COMMAND The Character Plot Command

● **Function**

CP command moves the pen by the designated number of character-space fields.

● **Format**

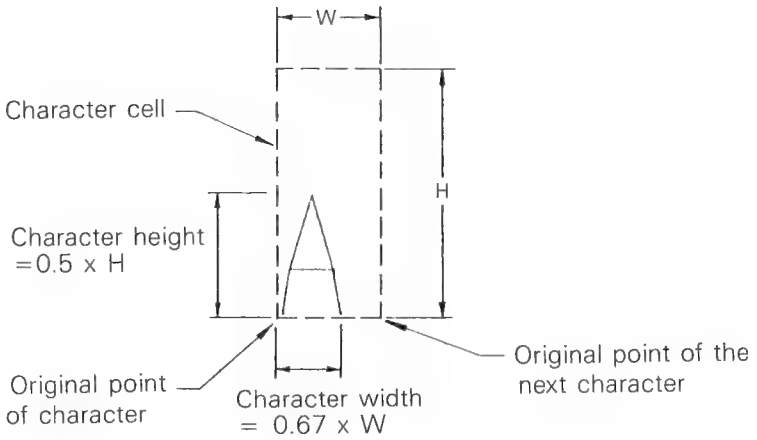
CP number of character-space fields in X-direction, number of character-space fields in Y-direction (number of lines) (terminator)
CP (terminator)

● **Example**

LPRINT "CP 10, −2;"
LPRINT "CP;"

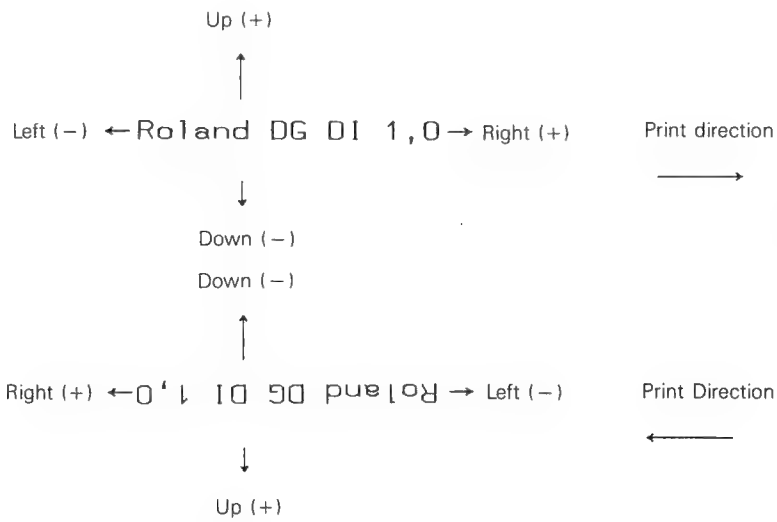
● **Description**

Character cell refers to an area of a character including spacing between characters. Relationship between character cell and character size is as shown below.



This is always constant, regardless of character size.

Parameters are values within −127 to +127; a positive value moves the pen right or up, or a negative value moves it left or down. Note that the direction varies with print direction as shown below.



The CP command with no parameters provides carriage return (CR) and line feed (LF). Since the CP command designates a moving distance of the pen by the number of character-space fields, it can be more conveniently used in printing than the PA or PR command.
A print example using the CP command follows. Note the left flush printing along the line.

[Example]

```
15000 '**** "CP"COMMAND ****
15010 LPRINT "IN;PA6000,3000;"
15020 LPRINT "SP1;SI;"
15030 LPRINT "CP5,-4;"
15040 LPRINT "LBCP INSTRUCTION";CHR$(&H3)
15050 LPRINT "PA6000,2000;PD9000,2000;PU7000,
       2000;"
15060 LPRINT "CP0,-1;"
15070 LPRINT "LBTHE";CHR$(&H3)
15080 LPRINT "CP;LBCHARACTER";CHR$(&H3)
15090 LPRINT "CP;LBPLOT";CHR$(&H3)
15100 LPRINT "CP;LBINSTRUCTION,CP"CHR$(&H3)
15110 LPRINT "PA0,0;SP0;"
```

For the same printing, line Nos. 15070 to 15100 can be changed as follows.

```
15070 LPRINT "LBTHE";CHR$(&HD);CHR$(&HA);
15080 LPRINT "CHARACTER";CHR$(&HD);CHR$(&HA);
15090 LPRINT "PLOT";CHR$(&HD);CHR$(&HA);
15100 LPRINT "INSTRUCTION,CP";CHR$(&H3)
```

CP INSTRUCTION

THE
CHARACTER
PLOT
INSTRUCTION,CP

"CS" COMMAND The Designate Standard Character Set Command

● **Function**

CS command designates one of the character sets to be used as the standard character set.

● **Format**

CS character set number (terminator)
CS (terminator)

● **Example**

LPRINT "CS 1;"
LPRINT "CS;"

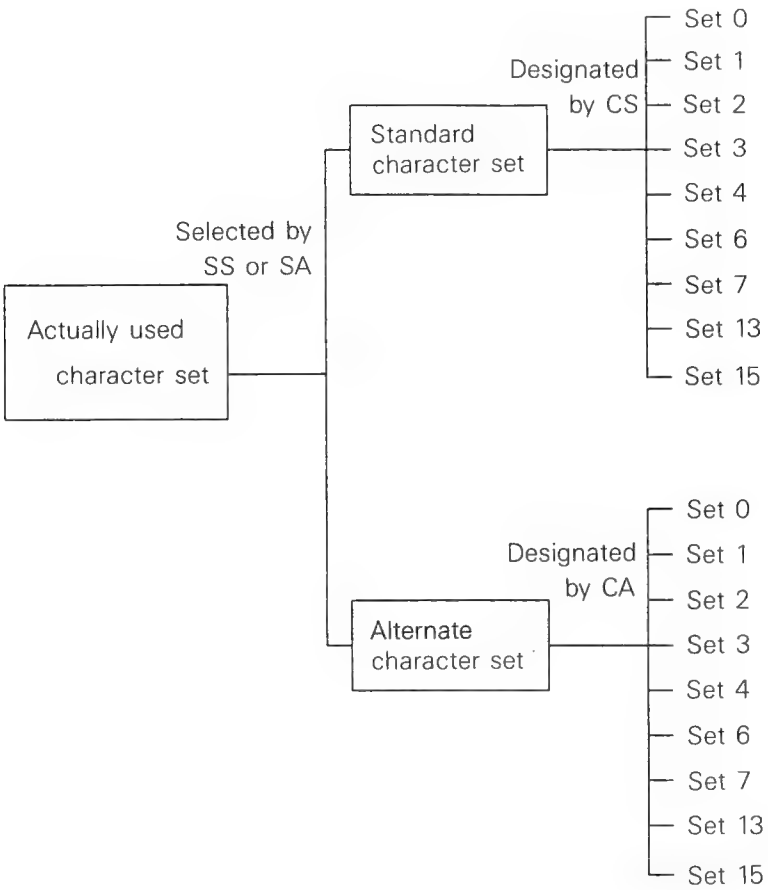
● **Default value**

"CS0;" (set 0)

● **Description**

DXY-880 has nine character sets. These are to plot character fonts other than English. Symbols are different by character set but numerical and alphabetical characters are the same. For symbols which are different by countries, refer to the attached Table (page 8-14). Character sets from No.0 to No.15 (a number not given in the table designates No.0) can be used with the CS command. The CS command with a parameter other than specified will cause an error and the command will be ignored. No parameter or initialization designates a character set designated by the DIP switch setting, both for the standard character set and alternate character set.
DXY-880 can designate two character sets, standard character set and alternate character set; either can be used for printing. When the standard character set is selected by the SS command or CHR$(15), character set selected by the CS command is used for printing, and when the alternate character set is selected by the SA command or CHR$(14), a character set selected by the CA command is used. Check which character set is selected, standard or alter-

nate character, when using the CS command. If it is unknown, enter the SS command before the CS command.
The relation is schematically shown below:



Different character sets are designated respectively for the standard character set and alternate character set initially in the program. A character set can be selected only by using the SS or SA command.
When one of the symbols surrounded by dotted lines in the character code table (page 8-14) is written, the cursor is automatically shifted back by a character. Therefore, when a character is added with an additional symbol, write the character first, then the additional symbol.

"CA" COMMAND The Designate Alternate Character Set Command

● Function

CA command designates one of the character sets to be used as an alternate character set.

● Format

CA character set number (terminator)
CA (terminator)

● Example

```
LPRINT "CA 1;;"
LPRINT "CA ;"
```

● Description

Designates an alternate character set in the same manner as the CS command. Character sets from No.0 to No.15 (a number not given in the character code table designates No.0) can be used with the CA command. The CA command with a parameter out of the specified range will cause an error and the command to be ignored.
Note that a character set designated by the CA command can only be printed when it is selected as an alternate character set by the SA command or CHR$(14). For details refer to the paragraph for the CS command.

"SS" COMMAND The Select Standard Character Set Command

● Function

The SS command designates the standard character set to be used for printing.

● Format

SS (terminator)

● Example

LPRINT "SS;"

● Description

After the SS command, a character set designated by the CS command is used for printing. This is effective until an alternate character set is selected by the SA command or CHR$(14) or re-setting by the DF or IN command.
In print mode, the standard character set can be selected by CHR$(15). This allows a text composed of English and German to be printed using only a single LB command, eliminating the need of dividing the LB command to execute the SS command.
This command requires no parameter. For the relation to the CS, CA and SA commands refer to the paragraph for the CS command.

"SA" COMMAND The Select Alternate Character Set Command

● Function

The SA command designates the alternate character set to be used for printing.

● Format

SA (terminator)

● Example

LPRINT "SA;"

● Description

After the SA command, a character set designated by the CA command is used for printing. This is effective until the standard character set is selected by the SS command or CHR$(15) resetting by the DF or IN command. In print mode, the alternate character set can be selected by CHR$(14).
This command requires no parameter. For the relation to the CS, CA and SS commands refer to the paragraph for the CS command.

"DT" COMMAND The Defined Terminator Command

● Function

The DT command specifies the character to be used as the label terminator, which is to release the plotter from print mode.

● Format

DT character (terminator)

● Example

LPRINT "DT";CHR$(3);";"

● Description

The DT command is used to change the label terminator when the standard setting label terminator, CHR$(3), cannot be used.
The ASCII control character "NULL" character (CHR$(0)) cannot be defined as a label terminator, however, normal function of the character is also executed,

or printed if it is a printable character. For example, when LF (CHR$(10)) is defined as a label terminator it releases the print mode and, at the same time, makes line feed. When "Z" is used as a label terminator, the print mode is released and Z is drawn at the end of the print. Normally, it is recommended to use a control code as a label terminator.

The DT command with no parameter does not re-set the label terminator to CHR$(3), because the command "DT;" defines ";" as a label terminator. Therefore, use the DF or IN command, or execute "DT"; CHR$(3) ; " ;", to re-set the label terminator to CHR$(3).

"UC" COMMAND The User Defined Character Command

● Function

The UC command is used to print characters which are not included in the character sets.

● Format

UC (pen control value,) ΔX1, ΔY1, (pen control value,) (ΔXn, ΔYn) ...., ... (terminator)
UC (terminator)

● Example

```
LPRINT "UC −99, 3, 9, 99 4, 5, 9, 3, ;"
LPRINT "UC ;"
```

● Description

The UC command uses three types of parameters, pen control value, X differential, and Y differential. Pen control value designates a pen up/down condition, −99 or less for a pen up, and 99 or more for a pen down condition. It is recommended to use −99 and 99. The pen always goes up when the plotter receives the UC command and, therefore, a pen down parameter should be placed in the UC command in order to make a print. After the UC command is completed, the pen goes up, moves to the left lower corner of the next right character cell, then returns to a pen condition before the execution of the UC command. X or Y differential designates a horizontal or vertical pen movement in grid unit. X and Y differentials should be greater than −99 and smaller than 99, and a decimal fraction can be used.
A character cell is divided horizontally into 6 sections and vertically into 16 sections to designate pen movement. (See Fig. 1)
An ordinary character is printed within the area surrounded by the dotted lines, horizontal 4 sections x vertical 8 sections. A character defined within the area has a normal character size. A character to be defined by the UC command is not required to be within a character cell. However, since the original point of a character is moved only by a character cell after printing, the PA, PR or CP command should be used to move the pen out of the defined area when the character to be printed is not within a single character cell. Otherwise, the next character will overlap the printed character.
See Fig.2. This is to draw an arrow mark, an example of the UC command. The original point of the character after executing the UC command is (6, 0), and the next character will overlap the end of the arrow if the next character is printed as it is. Then, "CP1, 0 ;" must be executed to move the original point to (12, 0).

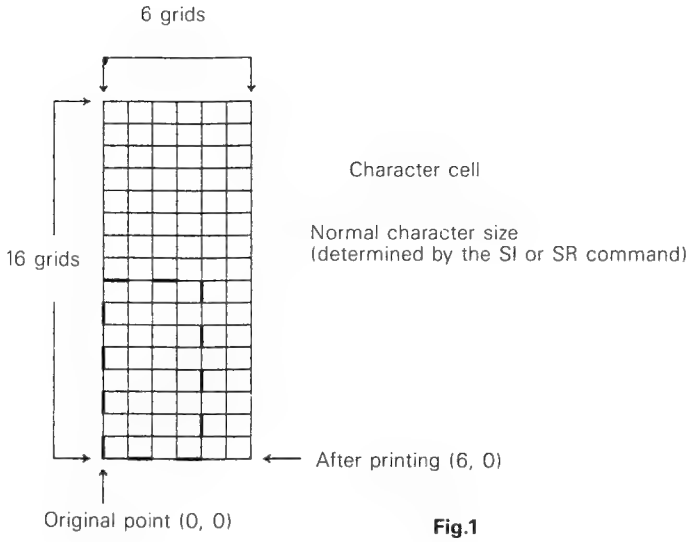
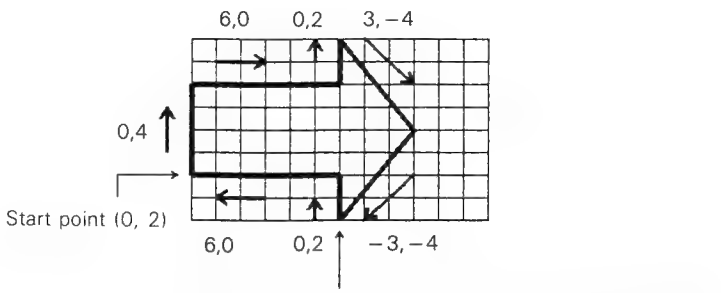


Fig.1



"UC 0,2,99,0,4,6,0,0,2,3,−4,−3,−4,0,2,−6,0 ;"

Fig.2

ENHANCEMENT DRAWING COMMANDS

XT, YT
TL
SM
FT
PT
RA
EA
RR
ER
WG
EW
AA
AR
CI

"XT" and "YT" COMMANDS The Tick Command

● Function

The XT command prints a tick of a length designated by the TL command on the X axis and the YT command prints it on the Y axis.

● Format

XT (terminator)
YT (terminator)

● Example

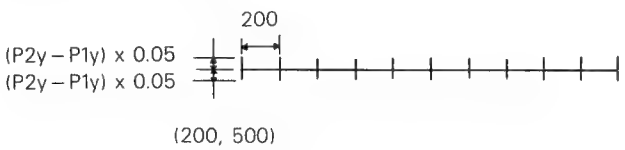
LPRINT "XT ;"
LPRINT "YT ;"

● Description

No parameter is required. This command prints a tick based on the current pen position, regardless of pen up/down condition. The tick length can be changed by the TL command. The default value of X axis tick is 0.5% of P2y − P1y in both positive and negative directions, and that of Y axis tick is 0.5% of P2x − P1x.
Examples of the XT command are shown below. In example 1, the tick is drawn while drawing the axis. In example 2, the axis is drawn, then the tick.

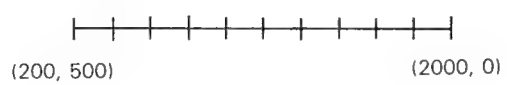
(Example 1)

```
1400 REM **** "XT"Command NO.1 ****
1410 LPRINT "IN;SP2;PA200,500;PD;XT;"
1420 FOR I=1 TO 10
1430   LPRINT "PR200,0;XT;"
1440 NEXT I
1450 LPRINT "PU;SP0;"
```



(Example 2)

```
1500 REM **** "XT"Command NO.2 ****
1510 LPRINT "IN;SP2;PA200,500;PD;"
1520 LPRINT "PR2000,0;XT;PU;"
1530 FOR I=1 TO 10
1540   LPRINT "PR-200,0;XT;"
1550 NEXT I
1560 LPRINT "SP0;"
```



"TL" COMMAND The Tick Length Command

● Function

The TL command designates a tick length in percentage (%) of the distance in X and Y directions between scaling points P1 and P2.

● Format

TL tick length in positive direction (, tick length in negative direction) (terminator)
TL (terminator)

● Exmaple

LPRINT "TL 10, 25;"
LPRINT "TL ;"

● Parameter range

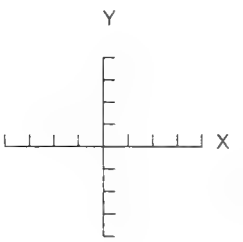
−127 to +127

● Default value

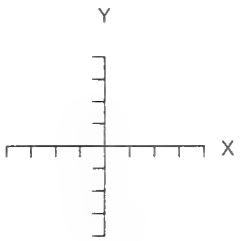
"TL 0.5, 0.5;"

● Description

Positive tick refers to up direction on the X axis and right direction on the Y axis, and negative tick refers to down direction on the X axis and left direction on the Y axis.



Positive direction



Negative direction

A parameter value of tick length for the XT command is a percentage of P2y − P1y, and for the YT command a percentage of P2x − P1x. The parameter range is from −127 to +127. 0 designates no tick. A parameter of 100 draws a tick of a length between points P1 and P2 in X and Y directions. Parameter 100 is used to delimit a table rather than for a tick.
Tick length is a portion of length in X and Y direction determined by point P1 and P2. Therefore, note that the length of X tick is different from that of Y tick when an area set by points P1 and P2 is not a square. When initialized or the TL command with no parameter is executed, it is automatically set to 0.5% of the length between point P1 and P2 in X and Y direction. Tick length in negative direction is set to 0 if it is not designated.
The TL command is effective until another TL command is executed or IN or DF command is executed.
Use a positive parameter in principle, because a negative parameter designates a tick length in the reverse direction.
A parameter out of the specified range will cause an error when the XT or YT command is executed.

"SM" COMMAND The Symbol Mode Command

● Function

The SM command draws a character or a symbol centering a point designated by the PA and PR command.

● Format

SM character or symbol (terminator)
SM (terminator)

● Example

LPRINT "SMK;"
LPRINT "SM;"

● Related commands

SI, SR, SL, DI, DR

● Default value

"SM;" (no symbol mode)

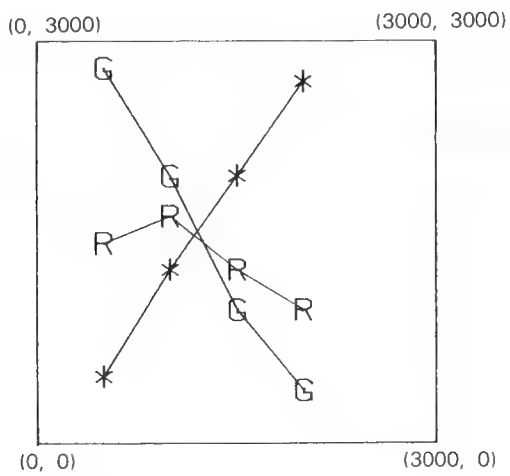
● Description

Parameter is limited to a single, printable character or symbol. After a character or symbol is designated by the SM command, it is printed centering a point designated by the PA or PR command. Once designated, it is effective until another character is designated (symbol mode is not released) or symbol mode is released. Symbol mode is released by the SM command with no parameter. The IN or DF command also releases the symbol mode.
A designated character is affected by a command that changes the size (SI or SR), slant (SL) or direction (DI or DR).
A semicolon (;) cannot be designated because it is regarded as a terminator. Also a space or control code cannot be designated.

The example shown below is to draw characters or symbols on curves.

(Example)

```
2000 REM **** "SM"Command ****
2010 LPRINT "IN;SP1;PA0,0;"
2020 LPRINT "PD0,3000,3000,3000,3000,0,0,0;PU;"
2030 FOR I=1 TO 3
2040   READ S$
2050   LPRINT "SM";S$;";"
2060   X=500
2070   FOR L=1 TO 4
2080     READ Y
2090     LPRINT "PA";X;",";Y;";PD;"
2100     X=X+500
2110   NEXT L
2120   LPRINT "PU;"
2130 NEXT I
2140 LPRINT "SM;PA0,0;"
2150 END
2160 DATA *,500,1300,2000,2700
2170 DATA R,1500,1700,1300,1000
2180 DATA G,2800,2000,1000,400
```



"FT" COMMAND The Fill Type Command

- **Function**

  Used in conjunction with the RA, RR, and WG commands to specify shading and hatching type.

- **Foramt**

  FT n, d, θ (terminator)

- **Example**

  LPRINT "FT 3;"

- **Parameter range**

  n: Type 1 to 4
  d: Spacing 0 to 32767
  θ: Angle −360 to +360

- **Default value**

  "FT 1, 186, 0,"

- **Description**

  n : Type
  The following three types are specified by number.
  1, 2 : Fill in both directions
  3 : Hatching (▤)
  4 : Cross hatching (▦)
  If the type is not specified, the default value of 1 is set.

  d : Spacing
  Used to specify the spacing between the parallel lines used for hatching and cross hatching. When n is 1 or 2 (filling) this parameter is ignored and the value specified with the PT command is used.
  When D is not specified, the D value specified with the previous FT command is set, if there is no previous FT command, the default value (1% of the P1, P2 spacing) is set.
  D is ignored if specified as 0 and the PT command value specified at that time is used.

  θ : Angle
  Specifies the angle of the lines used for shading and hatching in increments of 45°. If 0 is specified, horizontal lines are drawn, if 90 is specified, vertical lines are drawn and if 45 is specified, lines at 45° are drawn. If the angle is not specified, or if other than multiples of 45 are specified, the value specified with the previous FT command is set, if there is no previous FT command, 0 is set.

"PT" COMMAND The Pen Thickness Command

- **Function**

  Used to specify the shading space to suit the pen tip thickness.

- **Format**

  PT d (terminator)

- **Example**

  LPRINT "PT 0.4 ; "

- **Parameter range**

  0.1 to 5.0

- **Default value**

  "PT 0.3 ; "

- **Description**

  Parameters are specified in mm. If the shading space is not specified, a value of 0.3mm is set.
  The PT command is valid only for the pen being just used.
  When the SP command, or the DXY mode J command, is executed, the set value is ignored and the shading space is set at the default value of 0.3mm until it is set by the next PT command.

[Example]

```
1000 REM *** SHADING SAMPLE ***
1010 LPRINT "FT1,0,0;"
1020 LPRINT "PT0.1;"
1030 LPRINT "RA1000,1000;"
```

"RA" COMMAND The Shade Rectangle Absolute Command

- **Function**

Used in conjunction with the FT and PT commands to shade or hatch the inside of rectangle which is specified diagonally with both the current pen position and X, Y coordinates values.

- **Format**

RA X, Y (terminator)

- **Example**

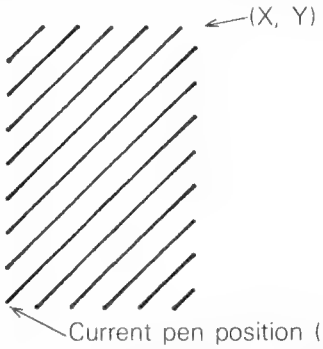
LPRINT "RA 2000, 2000; "

- **Parameter range**

−32767 to +32767

- **Description**

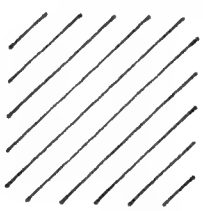
Hatches the inside of rectangle which is specified diagonally with the X and Y coordinates. Hatching begins from the current pen position.



When hatching is completed the pen returns to the start position.
Hatching is performed in accordance with the current FT and PT command settings (hatching type, shading space, angle).

[Example]

```
1100 REM *** HATCHING SAMPLE ***
1110 LPRINT "FT3,200,45;"
1120 LPRINT "PA;PU1000,1000;"
1130 LPRINT "RA2000,2000;"
```



"EA" COMMAND The Edge Rectangle Absolute Command

- **Function**

Used to draw a rectangle which is specified diagonally with both the current pen position and X, Y coordinate values.

- **Format**

EA X, Y (terminator)

- **Example**

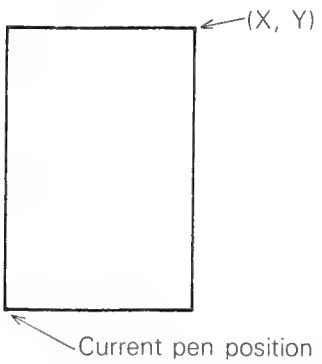
LPRINT "EA 2500, 3000;"

- **Parameter range**

−32767 to +32767

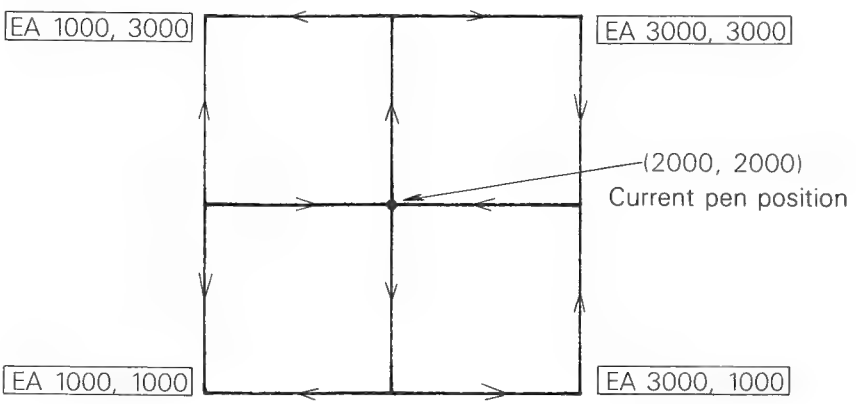
- **Description**

An EA command without parameters is ignored.
Draws a rectangle specified with the X and Y coordinates value. Drawing begins from the current pen position.



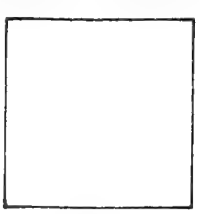
The pen returns to the start point after drawing is completed.

The drawing direction and position change in accordance with the parameter values for the pen position.



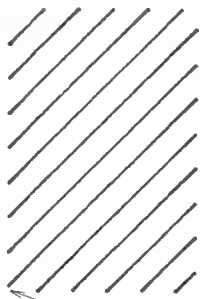
[Example]

```
1200 REM *** BOX SAMPLE ***
1210 LPRINT "PA;PU1000,1000;"
1220 LPRINT "EA2000,2000;"
```



"RR" COMMAND The Shade Rectangle Relative Command

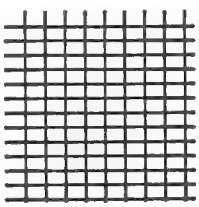
- Function: Used to shade or hatch a rectangle which is specified diagonally with both current pen position and X, Y coordinates values.
- Format: RR X, Y (terminator)
- Example: LPRINT "RR 2000, 2000;"
- Parameter range: −32767 to +32767
- Description: Hatches a rectangle specified with the X and Y increments. Hatching begins from the current pen position.



Hatching is performed in accordance with the current FT and PT command settings (hatching type, shading space, angle).
When hatching is completed the pen returns to the start position.

[Example]

```
1300 REM *** HATCHING SAMPLE (2) ***
1310 LPRINT "FT4,110,90;"
1320 LPRINT "PA;PU2000,2000;"
1330 LPRINT "RR1000,1000;"
```

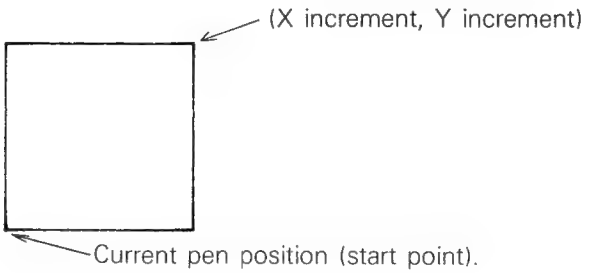


"ER" COMMAND The Edge Rectangle Relative Command

- Function: Used to draw a rectangle which is specified diagonally with both the current pen position and X, Y coordinates values.
- Format: ER X, Y (terminator)
- Example: LPRINT "ER 1500, 2000;"
- Parameter range: −32767 to +32767

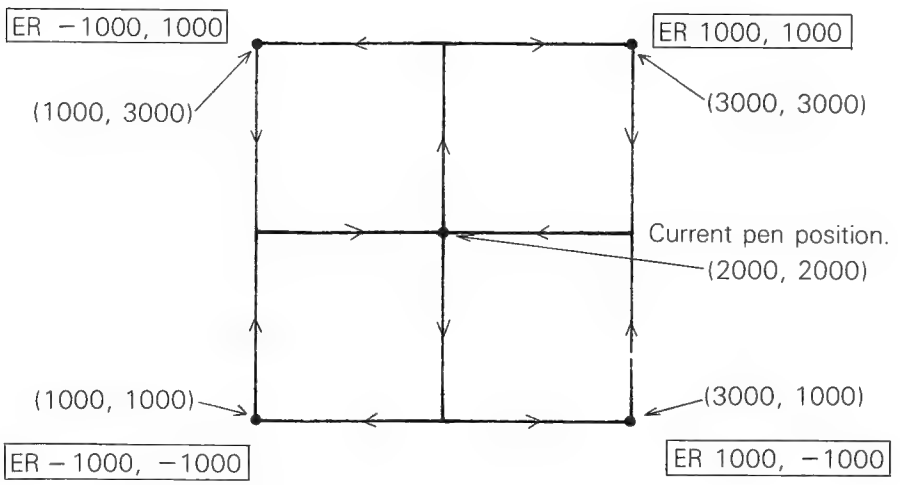
● Description

An ER command without parameters is ignored.
Draws a rectangle specified with the X and Y increments. Drawing begins from the current pen position.



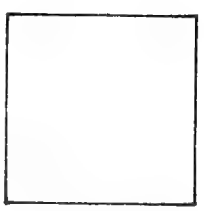
When drawing is completed, the pen returns to the start position.

The drawing direction and position change in accordance with the sign of the parameter.



[Example]

```
1400 REM *** BOX SAMPLE (2) ***
1410 LPRINT "PA;PU2000,2000;"
1420 LPRINT "ER1000,1000;"
```



"WG" COMMAND The Shade Wedge Command

● Function

Used to shade or hatch the inside of the wedge centered at the current pen position.

● Format

WG r, θ 1, θ c (terminator)

● Example

LPRINT "WG 1000, 90, 180, 5;"

● Parameter range

r : Radius −32767 to +32767
θ 1 : Start angle −360° to +360°
θ c : Center angle −360° to +360°

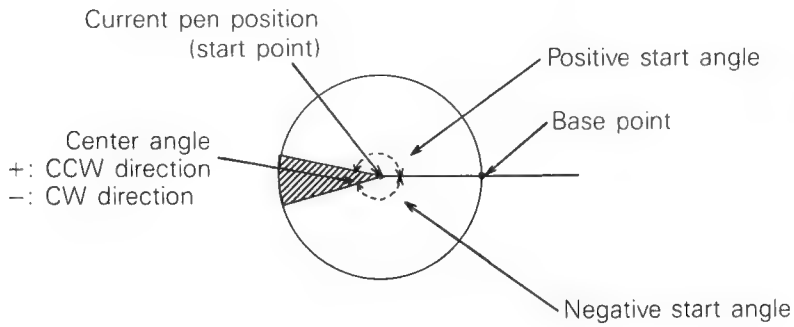
● Related commands

FT, PT, EW

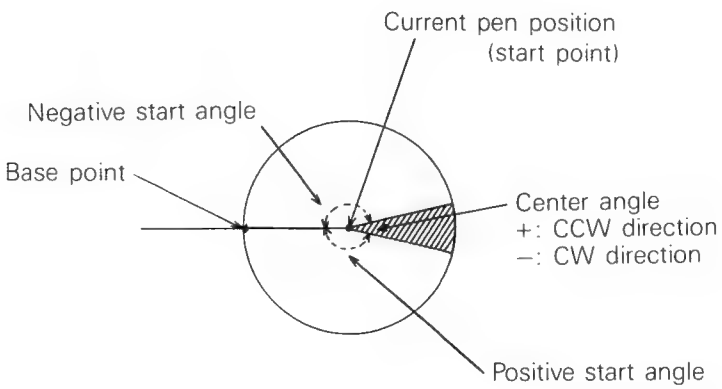
● Description

Hatching type, spacing, and angle are as specified with the FT and PT commands. As the base point differs with the sign of the radius parameter, care is required with its specification. The angle relative to the base point differs according to the sign of the start and center angle parameters.

•In case the radius is specified as a positive parameter.



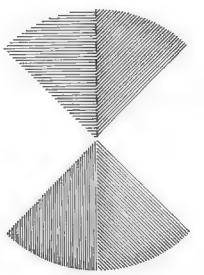
•In case the radius is specified as a negative parameter.



The pen returns to the start position after drawing is completed.

[Example]

```
1500 REM *** ARC HATCHING ***
1510 LPRINT "PA;PU2000,5000;"
1520 FOR I=1 TO 4
1530   READ A,A$
1540   LPRINT "FT3,50,";A
1550   LPRINT "WG";A$
1560 NEXT
1570 DATA 90,"2000,90,45,5",45,"2000,90,-45,5"
1580 DATA 0,"-2000,90,-45,5",135,"-2000,90,45,5"
```



"EW" COMMAND The Edge Wedge Command

- **Function**

  Used to draw a wedge.

- **Format**

  EW r, θ 1, θ c, (, θ d) (terminator)

- **Example**

  LPRINT "EW 1000, 90, 180, 5;"

- **Parameter range**

  r : Radius −32767 to+32767
  θ 1: Start angle −360° to +360°
  θ c: Center angle −360° to +360°
  θ d: Resolution 1° to 179.9999° (default value : 5°)

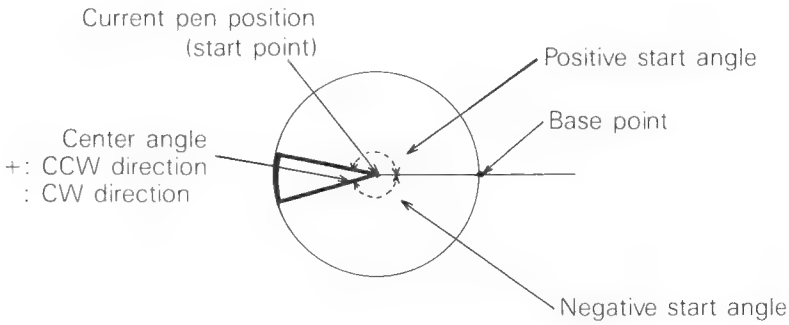
- **Related command**

  WG

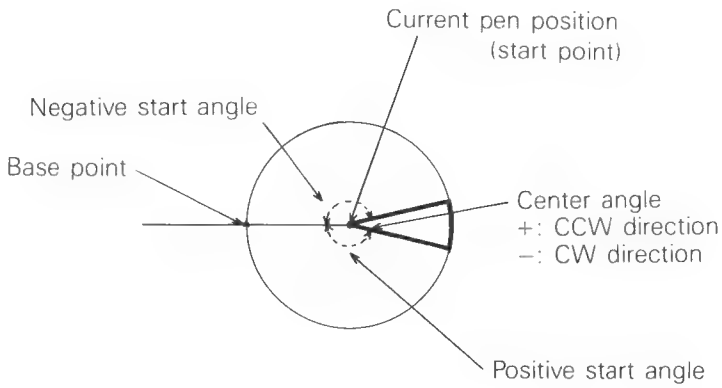
- **Description**

  This command is ignored unless the parameter is specified.
  When drawing is completed, the pen returns to the start position.
  As the base point differs with the sign of the radius parameter, care is required with its specification. The angle relative to the base point differs according to the sign of the start and center angle parameters.

•In case the radius is specified as a positive parameter.

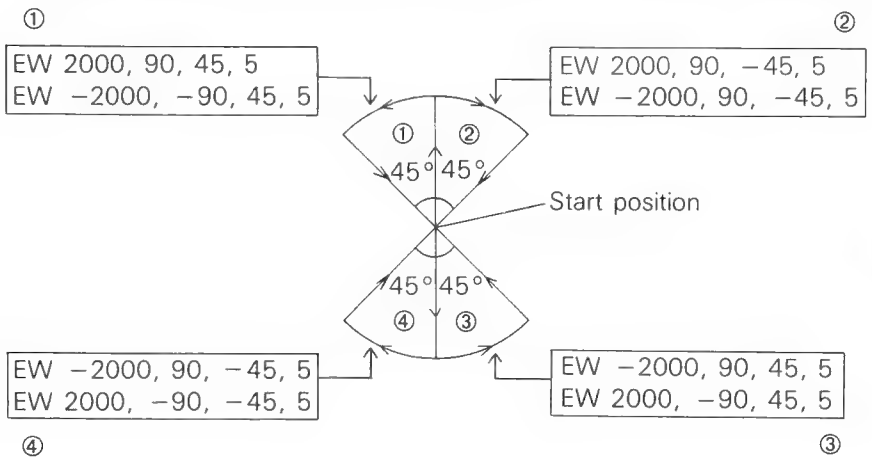


•In case the radius is specified as a negative parameter.



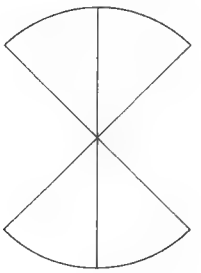
Resolution specifies the smoothness of circular arc of the wedge.
The parameter is specified, as an angle (°) within a range of 1 to 179.9999. When 1° or less is specified a resolution of 1° is set. It does not plot with resolution less the 1°. If resolution is not specified, 5° is set. Specified θd is adjusted into positive numbers to divide θc equally.

The drawing direction changes in accordance with the sign of the parameter.



[Example]

```
1600 REM *** ARC SAMPLE ***
1610 LPRINT "PA;PU2000,5000;"
1620 FOR I=1 TO 4
1630   READ A$
1640   LPRINT "EW";A$
1650 NEXT
1660 DATA "-2000,-90,45,5","-2000,-90,-45,5"
1670 DATA "2000,-90,-45,5","2000,-90,45,5"
```



"AA" COMMAND The Arc Absolute Command

● **Function**

Used to draw an arc centered on the specified X and Y coordinates.

● **Format**

AA X, Y , θc (, θd) (terminator)

● **Example**

LPRINT "AA 6000, 5000, 360, 10;"

● **Parameter range**

X, Y:	Center coordinates	−31200 to +31200
θc :	Center angle	−360° to +360°
θd :	Resolution	1° to 179.9999° (default value: 5°)

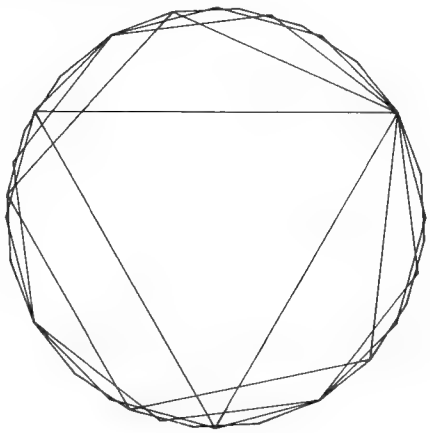
● **Description**

Draws an arc centered on the specified X and Y absolute coordinates, by the angle specified at θc, commencing from the current pen position.
Resolution specifies the smoothness of the arc.
The parameter is specified as an angle (°). When 1° or less is specified a resolution of 1° is set. It does not plot with resolution less the 2°. If resolution is not specified, 5° is set.
•Specified θd is adjusted into positive numbers to divide θc equally.

[Example]

As well as drawing circles and arcs, the resolution θd may be altered to enable drawing of the desired polygon.

```
1700 REM *** ARC ABSOLUTE SAMPLE ***
1710 LPRINT "PA;PU8000,6000;"
1720 FOR I=1 TO 5
1730   READ A:D=360/A
1740   LPRINT "SP";I;"AA6000,5000,360,";D
1750 NEXT
1760 DATA 20,12,8,5,3
```



"AR" COMMAND The Arc Relative Command

● **Function**

Used to draw an arc centered on the specified X and Y relative coordinates starting from the pen position.

● **Format**

AR Δ X, Δ Y, θ c (, θ d) (terminator)

● **Example**

LPRINT "AR 0, 200, 360, 10;"

● **Parameter range**

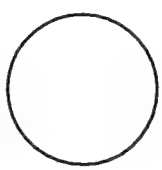
X, Y:	Relative center coordinates	−31200 to +31200
θc :	Center angle	−360° to +360°
θd :	Resolution	1° to 179.9999° (default value: 5°)

● **Description**

Draws an arc centered on the specified X and Y relative coordinates, starting from the current pen position, and by the angle specified at θc.
The details of resolution are referred to the section on the AA command.

[Example]

```
1800 REM *** ARC RELATIVE SAMPLE ***
1810 LPRINT "PA;PU6000,2000;"
1820 LPRINT "AR0,-500,360,10;"
```



"C I" COMMAND The Circle Command

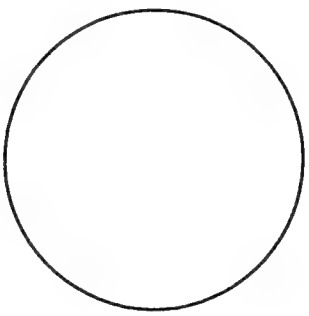
- **Function** — Used to draw a circle centered on the current pen position.
- **Format** — CI r, (, θd) (terminator)
- **Example** — LPRINT "CI 1000;"
- **Parameter range**

r : Radius	−32767 to +32767
θd: Resolution	1° to 179.9999° (default value: 5°)

- **Description** — Draws a circle of radius r centered on the current pen position. The detail of resolution is referred to the section on the AA command.

[Example]

```
1900 REM *** CIRCLE SAMPLE ***
1910 LPRINT "PA;PU6000,1500;"
1920 LPRINT "CI 1000;"
```



SCALE/WINDOW COMMANDS

I P

O P

S C

I W

O W

"IP" COMMAND The Input P1 and P2 Command

● Function

The IP command relocates scaling points P1 and P2 through program control.

● Format

IP P1x, P1y, P2x, P2y (terminator)
IP (terminator)

● Example

```
LPRINT "IP 0, 10, 10000, 5000;"
LPRINT "IP;"
```

● Parameter range and default value

Parameter range and default values vary with drawing size and mode.

Mode	Paper size	X	Y
DXY	A3 (ISO)	0 ~ 3800	0 ~ 2700
	A4 (ISO)	0 ~ 2700	0 ~ 1920
RD-GL	A3 (ISO)	0 ~ 15200	0 ~ 10800
	A4 (ISO)	0 ~ 10800	0 ~ 7680

● Description

Coordinates of P1 and P2 are designated in the plotter coordinates. Therefore, X and Y coordinates must be within the range shown above so that P1 and P2 are within the maximum plotting area.
A parameter out of the range results in one of the following.

$-32767 > X, Y$	····· Error
$-32767 \leqq X, Y < 0$	····· Set to 0
$15200 < X \leqq 32767$	····· Set to 15200
$10800 < Y \leqq 32767$	····· Set to 10800
$32767 > X, Y$	····· Error

The IP command without parameter defaults P1 and P2 to the initial values shown in the Table above.
The IP command is used to default P1 and P2 to given values or reset to the initial values. P1 and P2 serve to determine the positions to connect the plotter coordinates inherent in the plotter with user coordinate system having a given scale. User coordinate scale is designated by the SC command. When P1 and P2 are designated by the IP command, already designated SC values (default values are 0, 15200, 0, 10800) are assigned to points P1 and P2.

● To reduce A3 to A4

Suppose there is a program to draw in A3 size, which should be designed with maximum coordinates of 15200 × 10800. To reduce it to A4 size, the following command is executed to cause the plotter to reduce a pattern of 15200 × 10800 to 10800 × 7680, the maximum coordinates of A4 size.

```
LPRINT "IP 0, 0, 10800, 7680;"
```

● To reduce A3 to A5

To reduce an A3 size pattern to A5 and draw it in the upper right quarter of paper, the following command is executed.

LPRINT "IP 7680, 5400, 15200, 10800;"

The programs shown above assume that user coordinate SC values are the initial values (0, 15200, 0, 10800).
These coordinates are effective until another IN, SC or IP command is executed. Other than the IP command, P1 and P2 can be set by the panel switch, providing the same effect as with the command.

(For serial connection only)

"OP" COMMAND The Output P1 and P2 Command

● Function

The OP command allows P1 and P2 setting values to be acquired by a computer.

● Format

OP (terminator)

● Example

```
10 PRINT #1, "OP;"
20 INPUT #1, A, B, C, D
30 PRINT A, B, C, D
```

● Description

When the plotter receives the OP command, it outputs the following four coordinates in ASCII code.

P1x, P1y, P2x, P2y [TERM]

Each coordinate here is a plotter coordinate within a range of $0 \leqq X \leqq 15200$ and $0 \leqq Y \leqq 10800$. [TERM] is the output terminator for the interface connected.
Since the OP command only allows the coordinate values to be output, it is necessary to enter the external input command for your computer after the OP command so that the values are acquired by the computer.
For example,

INPUT #1, A, B, C, D

will assign the values of P1x, P1y, P2x and P2y to variables A, B, C and D respectively.
When the output is completed, bit 1 of the output status byte is cleared. This command permits you to know P1 and P2 coordinates which are manually set and serves to set a window in the area of P1 and P2 or for conversion between user coordinates and plotter coordinates.

"SC" COMMAND The Scale Command

● Function

The SC command sets user coordinates or returns user coordinates to plotter coordinates.

● Format

SC Xmin, Xmax, Ymin, Ymax (terminator)
SC (terminator)

● Example

```
LPRINT "SC 0, 10, 0, 10;"
LPRINT "SC;"
```

● Parameter range

Real number between −32767 and 32767

● Default value

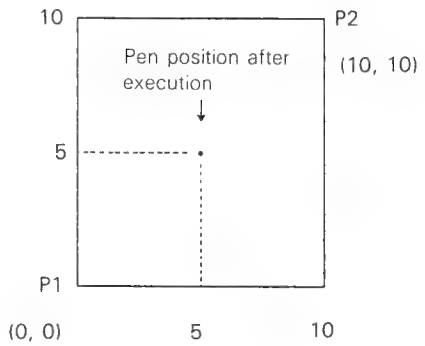
Depends on the DIP switch setting of the paper size mode.

● Description

The SC command with parameters sets the user coordinates of P1 to Xmin and Ymin and P2 to Xmax and Ymax. Each parameter must be a real number between −32767 and 32767, and be Xmax ≠ Xmin and Ymax ≠ Ymin. User coordinates once set are effective until they are rescaled by another SC command or returned to the plotter coordinates by the SC command with no parameters. While the command is effective, all plot command parameters are regarded as user coordinates. The SC command with no parameters also cancels the IP setting. Then the plot command parameters are the same as plotter coordinates and the plotter returns to an unscaled condition.
See the next example.
You will see a same plot command moves the pen to different positions depending on the scaling size.
When some data is to be plotted, the data can be used for the plot command parameters as they are by scaling so that the minimum value and maximum value of the data are just within the plotting area, providing easy programming.

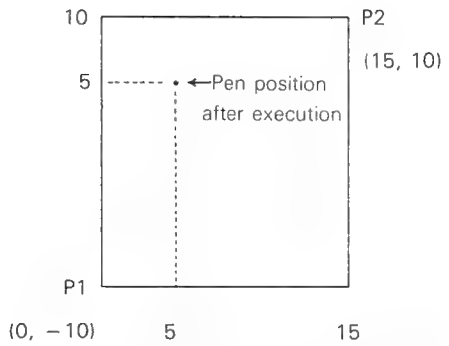
Example 1

```
SC 0, 10, 0, 10
PA 5, 5
```



Example 2

```
SC 0, 15, −10, 10
PA 5, 5
```



*Note that the order of parameters if different from other commands.

● To enlarge A4 to A3

The SC command provides a drawing scaling function in combination with the IP command. To make an enlarged drawing to A3 size (15200 × 10800) using a program for A4 size drawing (10800 × 7680), execute the following command:

LPRINT "SC 0, 10800, 0, 7680;"

This command is effective until another IN, DF, IP or SC command set to A3

size is executed.

*In enlarged drawing, an over-scaled part will be cut off by the window and not printed, but a calculation overflow may cause a deformation of drawing.

"IW" COMMAND The Input Window Command

● Function

The IW command is to define a plotting area. This area is called a "window".

● Format

IW X1 lower left, Y1 lower left, X2 upper right, Y2 upper right (terminator)
IW (terminator)

● Example

```
LPRINT "IW 0, 0, 100 100;"
LPRINT "IW;"
```

● Parameter range and default value

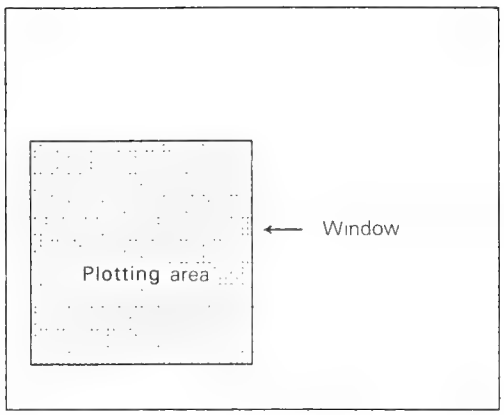
Parameter range and default values vary with drawing size and mode.

Mode	Paper size	X	Y
DXY	A3 (ISO)	0 ~ 3800	0 ~ 2700
	A4 (ISO)	0 ~ 2700	0 ~ 1920
RD-GL	A3 (ISO)	0 ~ 15200	0 ~ 10800
	A4 (ISO)	0 ~ 10800	0 ~ 7680

● Description

When the command has four parameters, the window is set according to the parameters. The command without parameter sets the window to the default values shown above.

Four parameters are determined as plotter coordinates and indicate X and Y coordinates of the lower left corner and upper right corner of the window.
If X1 value of the lower left corner is greater than X2 value of the upper right corner, or Y value of the lower left corner is greater than Y value of the upper right corner, no plotting can be made while no error will be developed.
Window is set to the default values after the power is switched ON or the IN or DF command is executed.
This command is used to restrict the plotting area when the paper is smaller than the plotting area or when a part of a plotting is to be plotted.



(For serial connection only)

"OW" COMMAND The Output Window Command

● Function

The OW command outputs coordinates of the lower left corner and upper right corner on the plotter to a computer.

● Format

OW (terminator)

● Example

```
PRINT #1, "OW;"
INPUT #1, A, B, C, D
PRINT A, B, C, D
```

● Description

This command is used with no parameter. When the plotter receives the command, it outputs plotter coordinates of the lower left corner and upper right corner of the window in ASCII code.
The order of the outputs is as follows.

X1 lower left, Y1 lower left, X2 upper right, Y2 upper right (terminator)

The terminator is a code indicating the end of output. [LF (10) or CR (13)]
Window size can be known by executing the OW command just after power ON or execution of the DF or IN command, which allows you to determine the setting of DIP switch SW1-7 and 8 (paper size). To know the window size, execute the OW command and read the values by the computer.

"OUTPUT" COMMAND

OA
OC
OE
IM
OS

Output commands can only be used when the plotter is connected through a serial port (RS-232C).
If the command is executed with the plotter connected through a parallel port, plotter output information will not be accepted by the computer and any information thereafter will not be received. In such a case, turn OFF then ON the plotter power to initialize the plotter.

"OA" COMMAND The Output Actual Position and Pen Status Command

● Function

The OA command allows plotter coordinates of X and Y of the current pen position and pen condition (up or down) to be read by a computer.

● Format

OA (terminator)

● Example

```
PRINT #1, "OA;"
```

● Description

Receiving the OA command, the plotter is ready to output the following three values in ASCII code.

X, Y, P [TERM]

Where X and Y are plotter coordinates within a range of $0 \leqq X \leqq 15200$ and $0 \leqq Y \leqq 10800$. P indicates the pen condition, 0 for a pen up and 1 for a pen down condition. [TERM] is an output terminator for the interface connected. This command can be used to manually move the pen to a desired position where a character or pattern is drawn and to know the coordinates, for easy pen positioning and window setting.
Before using the command in an actual program, open a file by using the OPEN statement.

```
PRINT #1, "OA;"
INPUT #1, X, Y, P
PRINT X, Y, P
```

"OC" COMMAND The Output Commanded Position and Pen Status Command

● Function

The OC command allows plotter coordinates or user coordinates of X and Y of the current pen position and pen condition (up or down) to be read by a computer.

● Format

OC (terminator)

● Example

```
PRINT #1, "OC;"
```

● Description

Receiving the OC command, the plotter is ready to output the following three values in ASCII code.

X, Y, P [TERM]

Where X and Y are coordinate values of plotter coordinates or user coordinates, P indicates the pen condition, 0 for a pen up and 1 for a pen down condition. [TERM] is an output terminator for the interface connected. When being scaled by the IP and SC commands, X and Y are user coordinates between −32767 and 32767 both for X and Y, decimal fractions being rounded to integers.
When not scaled, X and Y are plotter coordinates within a range of $0 \leqq X \leqq 15200$ and $0 \leqq Y \leqq 10800$.
Thus, when not scaled, the OC command has the same function as the OA command.
Before using the command in an actual program, open a file by the OPEN statement from the computer.

```
PRINT #1, "OC;"
INPUT #1, X, Y, P
PRINT X, Y, P
```

"OE" COMMAND The Output Error Command

● Function

When the OE command is received a computer reads the total bit value showing the meaning of errors generated.

● Format

OE (terminator)

● Example

PRINT #1, "OE;"

● Description

Receiving the OE command, the plotter is ready to output an error code in the following ASC II code.

Error code [TERM]

Where [TERM] is an output terminator for the interface connected. When the output is completed, bit 5 of the plotter status byte is cleared and the ERROR lamp stops flashing.
Error codes are defined as follows.

Bit value	Error No.	Meaning
0		No error
1	1	Unrecognizable command
2	2	Wrong number of parameters
4	3	Unusable parameter
8	4	Unused
16	5	Unusable character set designated
32	6	Coordinate overflow
64	7	Unused
128	8	Unused

Every RD-GL command is composed of two alphabetical characters.
① When uninterpretable command is received. 1 is output.
② When the specified number of parameters were not received, 2 is output.
③ When parameter value exceeds the specified range 4 is output.
④ When above errors of ① and ② were occurred consecutively, 3 is output.
The OE command is useful for debugging.
Before using the command in an actual program, execute the OPEN statement by the direct command from the computer to open a file.

```
PRINT #1, "OE;"
INPUT #1, E
PRINT E
```

"IM" COMMAND The Input Mask Command

● Function

The IM command sets the condition to notify the computer of a plotter error.

● Format

IM error mask value (, 0, 0) (terminator)
IM (terminator)

● Example

```
LPRINT "IM 223, 0, 0;"
LPRINT "IM;"
```

● Description

Error mask value is a sum of bit values (see Table below) of errors to be known. If an error of designated bit value generates, the error lamp on the front panel will flash.
For example, the standard error mask value, 223 (128 + 64 + 16 + 8 + 4 + 2 + 1) will cause the error lamp to flash when an error other than Error 6 generates. Since Error 4, Error 7 and Error 8 are not used, an error mask value of 23 other than the above has the same effect as the standard setting, 223.

Error mask bit value	Error No.	Meaning
1	1	Unrecognizable command executed
2	2	Wrong number of parameters
4	3	Parameter out of range
8	4	Unused
16	5	Unusable character designated
32	6	Coordinate overflow
64	7	Unused
128	8	Unused

The OE command can be used to know the error meaning when the error lamp of the plotter is flashing.
Error mask value is set to 223 by the standard setting or initial setting.
The IM command with no parameter or with a parameter out of the range sets the error mask value to the standard setting value, 223.

"OS" COMMAND The Output Status Command

● Function

The OS command allows status byte value to be read by the computer.

● Format

OS (terminator)

● Example

PRINT # 1, "OS ;"

● Description

The OS command is used for debugging operations and digitizing applications. No parameter is used with the command. Receiving the OS command, the plotter converts an 8-bit status byte value to the decimal value between 0 and 255, and is ready to output it in the following ASCII code value.

Decimal value of status byte [TERM]

Individual bits of the status byte are defined as follows:

Bit value	Bit position	Meaning
1	0	Pen down
2	1	P1 or P2 is changed (cleared by "OP")
4	2	Digitized point can be outputted by the OD command (cleared by "OD")
8	3	Initialized (cleared by "OS")
16	4	(Unused, always 1)
32	5	There is an error (cleared by "OE")
64	6	(Unused, always 1)
128	7	(Unused, always 0)

After power ON, the status byte is 24 in decimal. This is because bit 3 and bit 4 (initialized and ready to receive data) of the status byte are set, thus the sum of 8 and 16 is 24.
When the "OS" command is executed, bit 3 of the status byte is cleared. Before using the command in an actual program, execute the OPEN statement by the direct command from the computer to open a file.

```
PRINT #1, "OS;"
INPUT #1, S
PRINT S
```

DIGITIZE COMMANDS

DP
DC
OD

Digitize commands can only be used when the plotter is connected through a serial port (RS-232C).
If the command is executed with the plotter connected through a parallel port, plotter output information will not be accepted by the computer and no information thereafter will be received.
In such a case, turn OFF then ON the plotter power to initialize the plotter.

"DP" COMMAND The Digitize Point Command

● Function

The DP command sets the plotter to the digitize mode.

● Format

DP (terminator)

● Example

PRINT #1, "DP ;"

● Description

Receiving the DP command, the plotter is set to the digitize mode and ready to digitize.
By pressing the ENTER key, X and Y coordinate values of the current pen position and pen up/down condition are stored in the plotter. At the same time, bit 2 of the status byte is set and data of the digitized point are ready to be output.
The DP command uses no parameter.

"DC" COMMAND The Digitize Clear Command

● Function

The DC command terminates the digitize mode.

● Format

DC (terminator)

● Example

PRINT # 1, "DC ;"

● Description

When the DC command is received, the digitize mode is terminated. Coordinates are not stored.
The DC command uses no parameter.

"OD" COMMAND The Output Digitized Point and Pen Status Command

● Function

The OD command allows X and Y coordinates of the last digitized point and the pen condition to be acquired by the computer.

● Format

OD (terminator)

● Example

PRINT #1, "OD;"

● Description

When the OD command is received, the plotter is ready to output X and Y coordinates of the digitized point and the pen condition in the following ASCII form.

X, Y, P [TERM]

Here X and Y are plotter coordinates within a range of $0 \leqq X \leqq 15200$ and $0 \leqq Y \leqq 10800$. P is a variable indicating pen condition, 0 for a pen up and 1 for a pen down condition. [TERM] is an output terminator for the interface connected.
When the OD command is received, bit 2 of the status byte is cleared. Before using the command in an actual program, execute the OPEN statement by the direct command from the computer to open a file.

```
PRINT #1, "OD;"
INPUT #1, X, Y, P
PRINT X, Y, P
```

6

PRINTER MODE

1. Setting the printer mode 6-3

2. Application of the printer mode 6-3

1. Setting the printer mode

DXY-880 has a function to print characters corresponding to ASCII code inputs. This function is called "printer mode".

(1) After making sure that the power switch is turned OFF, set paper and pen.
* For the paper setting method refer to page 2-8.
* This mode uses only a single pen. Set a pen on pen clip No. 1.

(2) Make sure that the pen carriage is set to the standby position.

(3) While pressing the HOME key, turn ON the power switch.

(4) The pen carriage takes up pen No. 1 and moves to the upper left corner of the paper, and waits for input.
(A position of 0 mm on the X axis and 255 mm on the Y axis with respect to the coordinate original position.)

(5) By executing LLIST by the computer, 130 characters per line, up to 48 lines, can be printed with a character size of 1.9 mm in width and 2.7 mm in height.

(6) After having printed the 48th line, the pen returns to the upper left corner of the paper for standby.

(7) To continue printing, replace paper and press the HOME key.

(8) To release the printer mode after having printed character strings, turn OFF the power switch. (The plotter will not be reset to the plotter mode by any command.)

(Reference)
The plotter can be set to 80 characters per line by executing WIDTH LPRINT (80) in BASIC language before LLIST.

Note:
LLIST in the printer mode is effective only when the plotter is connected in parallel with the computer and the computer has the LLIST command.

2. Application of the printer mode

The printer mode is an effective means for checking drawing data and for debugging drawing programs, since the character strings of commands and parameters despatched to the plotter are printed as they are.
The procedure is the same as the printer mode setting. Then, execute the program with RUN, and command characters and parameter numbers are printed on paper, the carriage return (CR) command brings the pen back to the top of the line, as well as a line feed and the line feed (LF) command makes only a line feed, providing a hint for finding out a mis-programming.

Note:
- Either parallel or serial connection can be used.

- In the printer mode, if the PAUSE key is pressed while the pen is in a standby condition waiting at the upper left corner of paper, no printer mode function will be executed by pressing the HOME key.
Press the PAUSE key again to release it, then press the HOME key. Same as for LLIST.

7

HANDSHAKING

1. **Hardware handshake** 7-3
2. **Software handshake** 7-4
3. **X on/X off handshake** 7-5
4. **ENQ/ACK handshake** 7-6
5. **Monitor mode** 7-7
6. **Device control commands** 7-9

This chapter explains how to handshake using the serial interface (RS-232C).
In case data is sent to the plotter from the computer, because of slower processing speed at plotter, data is lost and misinterpreted. To prevent this the data from computer is to be controlled, which is called handshaking. DXY-880 supports 4 types of handshaking.

1. Hardware handshake

The DXY-880 supports a function to switch DTR ON/OFF according to the remaining capacity of the buffer.

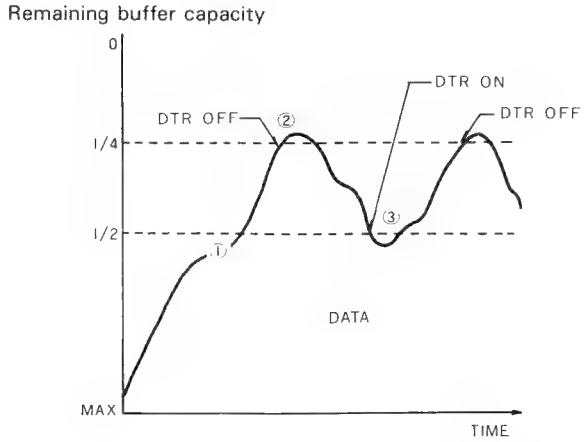


Fig.1

[Setting]
Set hardware handshake ON by the power ON default, or the ESC. @ command.

```
PRINT #1,CHR$(27);".@0;1:"
```

[Operation]
The DTR signal differs according to the following conditions.

① When 1/4 or more of the buffer capacity remains DTR:ON (+12V)
② When 1/4 or less of the buffer capacity remains DTR:OFF(−12V)
③ When remaining buffer capacity increases to 1/2 or more DTR:ON (+12V)

Hardware handshake is possible if the computer supports a function to halt data transmission when input is LOW at the CTS, DSR, or CD terminals.

[Connection example] IBM-PC / APPLE II, IIe (DTE type)

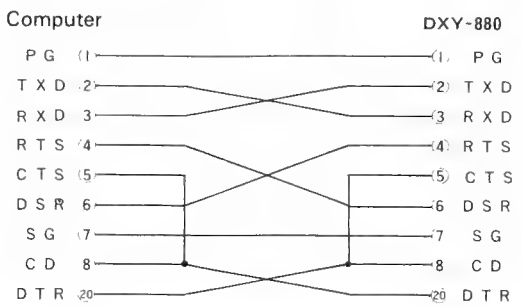


Fig.2

- DXY-880 buffer capacity
  Standard DXY-880 : 3K byte
  With expansion RAM installed (option) : 10K byte

2. Software handshake

The DXY-880 supports a function to output buffer status to the computer. The use of this function enables the sending of data while checking the remaining buffer capacity with software.

Software handshake example (for IBM PC)

```
100 ' DXY-880 RS-232C DEVICE CONTROL COMMAND
110 '  SAMPLE PROGRAM FOR SOFTWARE HANDSHAKE
120 OPEN "COM1:1200,E,7,1,CS65535" AS #1
130  PRINT #1,CHR$(27);".M100;;;13:";
140 ' MAIN PROGRAM
      .
      .
      .
      GOSUB 1000
      .
      .
      .
      GOSUB 1000
      .
      .
      .
      END
1000 ' SUBROUTINE BUFFER CHECK
1010   PRINT #1,CHR$(27);".B"
1020   INPUT #1,B
1030   PRINT "Buffer space :";B
1040   IF B>=1500 THEN RETURN
1050   GOTO 1010
```

Main program to plot

Line 120 : Alter this line to suit the file opening commands for your computer.
Line 130 : Set to suit your computer.
Line 1000 : } Checks the remaining buffer capacity and waits for transmission
Line 1050 . } if 1/2 (1500 bytes) or less of the buffer capacity remains.

Line 130 sets a delay time of 100msec between reception of an output request from the computer and the DXY-880 response to this request. The terminator for the output data is set as character code 13(CR).
Line 1010 is an output command for DXY-880 to output its remaining buffer capacity.
These commands are termed device control commands. See the section on device control commands for details.
In this example, the remaining buffer capacity is checked in lines 1000 ~ 1050 and data transmission adjusted. This checking requires the use of the GOSUB 1000 at various locations within the main program.

- Particular care must be taken in this case to ensure that data sent continuously does not exceed the buffer capacity.

3. X on/X off handshake

```
100 ' DXY-880 RS-232C DIVICE CONTROL COMMAND
110 '  SAMPLE PROGRAM FOR Xon/Xoff HANDSHAKE
120 OPEN "COM1:1200,E,7,1,CS65535" AS #1
130 ON COM(1) GOSUB 1000
140   PRINT #1,CHR$(27);".M0;0;0;13;0;0:";
150   PRINT #1,CHR$(27);".I150;0;17:";
160   PRINT #1,CHR$(27);".N;19:";
170   PRINT #1,CHR$(27);".@;0:";
180 COM(1) ON
190 ' MAIN PROGRAM
        :                                          } Main program to plot
      END
1000 'INTERRUPT Xon/Xoff
1010   A$=INPUT$(1,#1)
1020   IF A$=CHR$(19) THEN PRINT "Xoff   "
1030   COM(1) OFF
1040   PRINT "wait !!"
1050   A$=INPUT$(1,#1)
1060   IF A$=CHR$(17) THEN PRINT "Xon    " :COM(1) ON:RETURN
1070   PRINT "ILLEAGAL Xon !!"
1080   RETURN
```

Line 120 : Alter this line to suit the file opening commands for your computer.
Line 140 : } Setting for X on/X off handshake.
Line 170 :
Line 1000 : } Process the interrupt signal from the plotter.
Line 1080 :

Setting with lines 140～170 results in the following plotter operation.

① Character code 19 is output as X off when the remaining buffer capacity becomes 150 bytes or less.

② Character code 17 is output as X on when the remaining buffer capacity becomes 1/2 or more of the total.

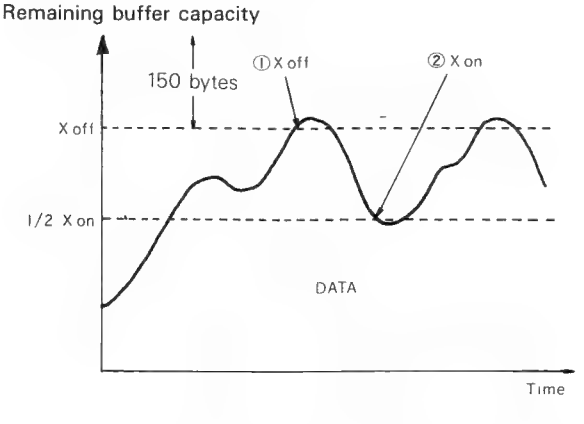


Fig.3

As these signals are output as interrupt during computer operation, the computer must support a function for reception of interrupt.
When interrupt is received program execution jumps to lines 1000～1080; if the interrupt signal is X off the computer waits until X on is received.

- When X on/X off are set and the ESC.L command is executed, the plotter outputs a buffer size of 256 bytes less than the actual capacity.

4. ENQ/ACK handshake

```
100 'DXY-880 RS-232C DEVICE CONTROL COMMAND
110 '   SAMPLE PROGRAM FOR ENQ/ACK HANDSHAKE
120 OPEN "COM1:1200,E,7,1,CS65535" AS #1
    :OPEN "DATA1" FOR INPUT AS #2
130 ON COM(1) GOSUB 1000
140 COM(1) ON
150 PRINT #1,CHR$(27);".@;0:";
160 'SET HANDSHAKE MODE ENQ/ACK
170 PRINT #1,CHR$(27);".M0;0;0;0;0;0:";
180 '  ENQ character = CHR$(7)
190 '  ACK character = CHR$(6)
200 PRINT #1,CHR$(27);".H256;7;6:";
210 ' MAIN PROGRAM
220 PRINT "***ENQ !!":PRINT #1,CHR$(7)
230 'Current Job
        .
        .
        .
        .  Main program
        .
        .
      END
```

* All job but plotting by DATA 1.

```
1000 'BLOCK TRANSFER
1010 PRINT "ACK !!":ACK$=INPUT$(1,#1)
1020 IF ACK$<> CHR$(6) THEN RETURN
1030   FOR I=1 TO 256
1040     IF EOF(2) THEN GOTO 1100
1050     INPUT #2,A$
1060     PRINT #1,A$;
1070     PRINT A$;
1080   NEXT I
1090 PRINT "***ENQ !!":PRINT #1,CHR$(7);:RETURN
1100 PRINT "DATA END !!":RETURN
```

Line 120 : Opens two files. Alter this line to suit the file opening commands for your computer.

Line 150 :
〃 } Setting for ENQ/ACK handshake
Line 200 :

Line 220 : Sends the ENQ signal to the plotter.

Line 1010 :
〃 } Main program exited with reception of the ACK signal from the plotter, and 256 bytes of data then sent to the plotter.
Line 1100 :

The setting in lines 150 ~ 200 is such that character code 7 is sent to the plotter as the ENQ signal, and the plotter sends character code 6 to the computer as the ACK signal if more than 256 bytes or more of buffer capacity remain.

This program checks the plotter status during execution of main program and outputs one block of data (256 bytes of plotter data in this case*) with interrupt operation if sufficient buffer space remains. If insufficient buffer space remains, or there is no output data, the main program is processed. The use of these four types of handshaking prevents data from being lost or the use of ENQ/ACK handshaking utilizes available space time at computer for effective jobs other than plotting.

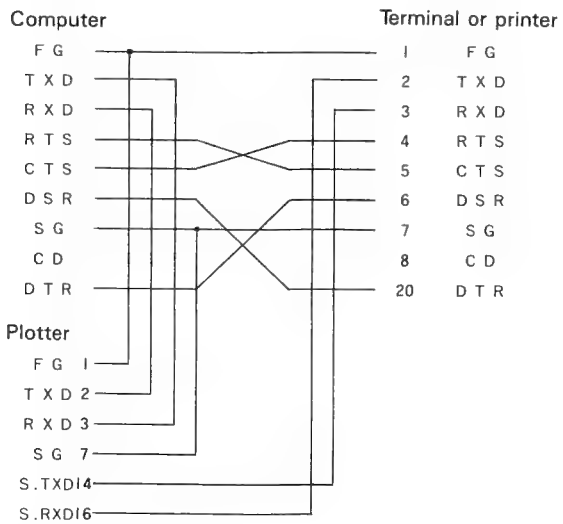
* This assumes that data sent to the plotter is written into file #2 DATA 1. Execution of the following writes the file DATA 1 onto the disk.

```
10 OPEN "A:DATA1" FOR OUTPUT AS #1
20 PRINT #1,"      "
 .                .
 .                .
 .                .  Plotter data
 .                .
 .                .
 .                .
1000 END
```

5. Monitor mode

The previous sections have described connection of the DXY-880 and the computer. This section describes the use of the DXY-880 in the monitor mode to allow connection of the computer, DXY-880, and a terminal or printer using one RS-232C port.
An example of a cable used in the monitor mode is shown below.

Fig.4



[Monitor mode setting]

Set switch ON # 6 on the DIP switch 1 (SW1) in the DXY-880 (Y mode). When power is switched ON in this mode, the DXY-880 is set in the monitor mode and all data is ignored until ESC.Y or ESC.(is received program ON). Following input of ESC.Y, the following modes may be selected by inputting the ESC.@ command.

	DTR status	Mode	Monitor status	Response	
				Computer	Terminal
0	Height		Monitor mode cleared	Response to all commands	No response
1	Hardware handshake				
4	Height				
5	Hardware handshake				
8	Height	Mode 0	Monitor mode		Mode 0
9	Hardware handshake				
12	Height	Mode 1			Mode 1
13	Hardware handshake				

DTR

Height ... Hardware handshake always cleared in the height status.
Hardware handshake ... Hardware handshake status.

Mode

0 ... The plotter stores data from the computer into the plotter buffer. When the plotter executes the data stored in the buffer, the data being executed are echoed back to the terminal, except device control commands.

1 ... All data received by the plotter from the computer is echoed back to the terminal.

When ESC.Z or ESC.) is received the plotter ignores all following commands. The ignored data is echoed back to the terminal (program OFF).

*When the DXY-880 is located between the computer and the terminal the data is sent via the DXY-880 processor. The DXY-880 power supply, therefore, must be ON for communication between the computer and terminal.

6. Device control commands

The following commands are valid only when the serial interface (RS-232C) is connected.

HANDSHAKE MODE COMMANDS

ESC. M
ESC. B
ESC. I
ESC. H
ESC. N

STATUS COMMANDS

ESC. E
ESC. L
ESC. O

ABORT COMANDS

ESC. J
ESC. K
ESC. R

MONITOR MODE COMMANDS

ESC. Y
ESC. Z
ESC. @

HANDSHAKE MODE COMMANDS

"ESC.M" COMMAND

● Format

ESC M P1;P2;P3;P4;P5;P6:

● Explanation

< P1 >
Determines the delay time between when the computer requires output from the plotter and the plotter begins output.
Program example : ESC . M 100 :
This sets the delay time to 100msec. The parameter range is 0 to 32000.

< P2 >
Sets the trigger character. The plotter only sends data after this character set in P2 is received.
Program example : ESC . M;13 :
P1 is initially set to 0, the trigger character code is 13 (CR:carriage return). If, for example, ESC . B is sent to the plotter, reception by the plotter of the next carriage return (CR) will result in output of the remaining buffer capacity to the computer.

< P3 >
Sets the echo-back terminator. When the computer echoes back again the data sent from the plotter to the plotter, the plotter ignores all data until the terminator character set in P3 is received.
Program example : ESC . M; ;10:
P1 and P2 are set at the initial values, and the line-feed code (10) is used as the echo-back terminator so that the computer must output data to the plotter after echo-back.

< P4, P5 >
Sets the output terminator. Outputs as the terminator for data output by the plotter.
Program example : ① ESC . M; ; ;13:
② ESC . M; ; ;13; 10;0:
In the example ①, the carriage return code (13:CR) is output as the terminator, in the example ②, the carriage return (13:CR) and line feed (10:LF) codes are output P6 must be set to 0 in this case.

< P6 >
The plotter sets the character output before data is sent to the computer.
Program example : ESC . M; ; ;13;0;33:
"!" is output to the computer before the data. P5 must be set to 0 in this case.

"ESC.B" COMMAND

● Format

ESC . B

● Explanation

Outputs the current number of empty buffers to the computer. As this command is used by the computer to check the number of empty buffers, data equal to or less than this value may be output to the plotter. This command may be used to prevent buffer overflow.

"ESC.I" COMMAND

● Format

ESC . I P1;P2;P3;.....;P12:

● Explanation

Used in conjunction with the ESC.N command when X on/X off handshake is used.

< P1 >
When the number of empty buffers is less than the number set in P1, the plotter outputs the X off character.
Program example : ESC . I 100; ; 17: ESC . N;19:
When the numbers of empty buffer become by 100 bytes the X off character is output. The parameter range is 10 to 256.

< P2 >
Always set to 0 in the case of X on/X off.
Program example : ESC . I; ;17: ESC . N;19:
ESC . I;0;17: ESC . N;19:
P1 is set to the initial value of 80 bytes, the X on character is DC1 (17), and the X off character is DC3 (19).

< P3~P12 >
Sets the X on character (see P2). A string of up to 10 characters may be set. The individual character codes are delineated by a semicolon.

"ESC.H" COMMAND

● Format

ESC . H P1;P2;P3;.....;P12:

● Explanation

Sets ENQ/ACK handshake. When the computer sends the ENQ character to the plotter, the ACK character is output only when the number of empty buffers is available more than the value set in P1. When the ACK character is received by the computer, data equal to the number of bytes set in P1 is output in one block.

< P1 >
Sets the number of bytes in the data blocks sent to the plotter from the computer. When the plotter receives the ENQ character, the ACK character is output if the number of empty buffers is more than the value set in P1.
Program example : ESC . H 128;5;6:
In this example each data block has a size of 128 bytes, the ENQ character is ENQ(5), and the ACK character is ACK(6).
The parameter range is 0 to 256.

< P2 >
Sets the ENQ character. When the plotter receives this P2 code, the ACK character is output if the number of empty buffers set in P1 is available, and then waits for data from the computer.

< P3~P12 >
Sets the ACK character. A string of up to 10 characters may be set (see ESC.I).

"ESC.N" COMMAND

- Format
- Explanation

[ESC] . N P1;P2;.....;P11:

Output by the plotter. Sets the delay time between characters. Also sets the X off character.

< P1 >
The range is 0 to 32000. Sets the interval time between characters in the character string output by the plotter.
Program example : [ESC] .N10:
When [ESC] . L is sent to the plotter, the plotter outputs "3072 [CR] . " In this case each of the terminators and characters is sent to the computer at 10 msec. intervals (see ESC.M).

< P2~P11 >
Sets the X off character. A string of up to 10 characters as maximum may be set (see ESC.I).

STATUS COMMANDS

"ESC.L" COMMAND

● Format

ESC . L

● Explanation

When the plotter receives the command, it outputs the size of buffer to the computer. In case of 3K bytes buffer, which is standard, 3072 is normally output; however when the optional 10K byte buffer is used, 10240 is output.

"ESC.E" COMMAND

● Format

ESC . E

● Explanation

When the plotter receives this command, it outputs the error code for RS-232C and clears the error display simultaneously.

Error codes

0 An I/O error has not occurred.
10 While an output request is executed, another command requesting output will not be received, but only the first command is valid.
11 A device control command error has occurred.
12 When a device control command parameter is unsuitable, the parameter causing the error is initialized.
13 When a parameter has overflowed.
14 When too many parameters are input, or parameters are not delineated by " : ".
15 When a framing error, parity error, or overrun error has occurred during reception of data.
16 When the input buffer has overflowed. In this case normal drawing operation is impossible.

"ESC.O" COMMAND

● Format

ESC . O

● Explanation

Outputs the plotter status as a code.

Code	Buffer capacity status
8	Empty buffers are 1/2 the buffer capacity.
16	Empty buffers are 1/4 or less of the total, and the PAUSE switch is pressed.
24	Empty buffers are 1/2 or more of the total, and the PAUSE switch is pressed.

ABORT COMMANDS

"ESC.J" COMMAND

- Format: [ESC] . J
- Explanation: Aborts the device control command currently being executed.

"ESC.K" COMMAND

- Format: [ESC] . K
- Explanation: Aborts plotting operation and clears all data in the buffer.

"ESC.R" COMMAND

- Format: [ESC] . R
- Explanation: Initializes all the handshake command parameters.

Default values

[ESC] . M:
[ESC] . M0;0;0;13;0;0:

[ESC] . I :
[ESC] . I 80;0;0;..... 0:

[ESC] . H 80;0;0; 0:

[ESC] . N:
[ESC] . N0;0:

[ESC] . @ :
[ESC] . @ 0;1: (Set to the hardware handshake mode.)

MONITOR MODE COMMANDS

The DXY-880 supports a function to output data sent from the computer to a printer or terminal. The cable used in this case is shown in Fig.4.
The commands explained below are valid only when No.6 on the plotter DIP switch 1 is set to ON (ie. the Y mode).

"ESC.Y" COMMAND

- Format: ESC . Y or ESC . (
- Explanation: After plotter power is ON, all data is ignored until this command is received. The ignored data is output to the terminal via pin No.14 of the 25-pin connector.

"ESC.Z" COMMAND

- Format: ESC . Z or ESC .)
- Explanation: When this command is received, all following data sent from the computer is ignored.

"ESC.@" COMMAND

- Format: ESC . @ P1 ; P2 :
- Explanation:

< P1 >
Ignored.

< P2 >
Sets the DTR signal (25 pin connector, pin No.20) control and the monitor mode.

● Parameter bits
Example 1 : ESC . @;0:
Keep monitor mode OFF and DTR signal always ON. In this case, data following the ESC . Y command is received by the plotter only and not output to the terminal. Hardware handshake is not performed.

Examle 2 : ESC . @;8:
Set monitor mode ON, and mode 0. In mode 0, the data stored in the plotter buffer is output to the terminal (or printer).

Example 3 : ESC . @;12:
Set monitor mode ON, and mode 1. In mode 1, the data received by the plotter from the computer is output to the terminal (or printer).

8

APPENDIX

1. Plotter control 8-3
2. Errors 8-8
3. Commands list 8-9
4. DIP switch setting list 8-13
5. Character code table 8-14
6. Sample programs 8-15
7. Specifications 8-24

1. Plotter control

- Connection types

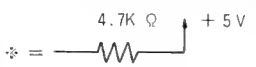
a. Parallel connection

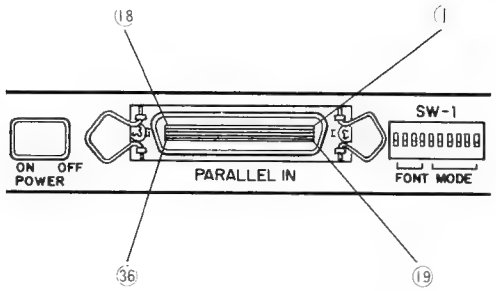
The input terminal of DXY-880 is compatible with Centronics Standard and can be connected to printer ports of most computers, using a printer cable. For methods of connection with various computers refer to Paragraph 2–7 (page 2-13). The DXY-880 specification is as follows.

- Connector

Use DDK 57-30360, AMP 552235-1 or equivalent. The plotter is provided with HRS RC10-36R3-LW or equivalent.

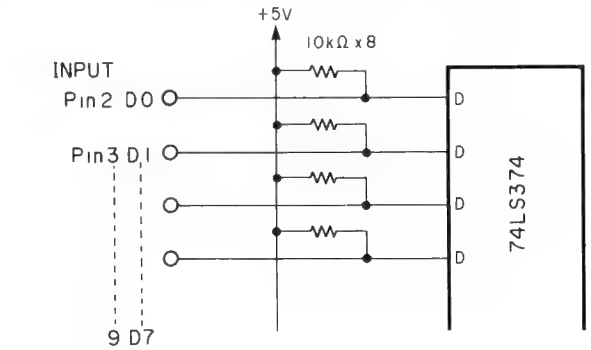
NC	36	18	NC
NC	35	17	GND
NC	34	16	〃
GND	33	15	NC
HIGH ※	32	14	NC
NC	31	13	HIGH ✣
GND	30	12	GND
〃	29	11	BUSY
〃	28	10	$\overline{\text{ACK}}$
〃	27	9	D 7
〃	26	8	D 6
〃	25	7	D 5
〃	24	6	D 4
〃	23	5	D 3
〃	22	4	D 2
〃	21	3	D 1
〃	20	2	D ϕ
〃	19	1	$\overline{\text{STROBE}}$

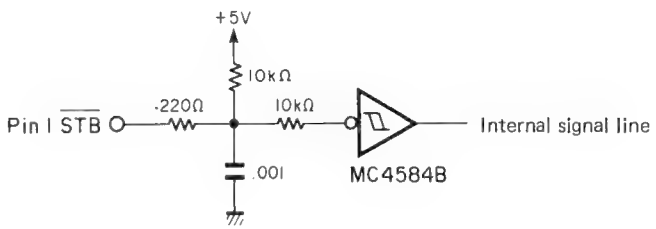


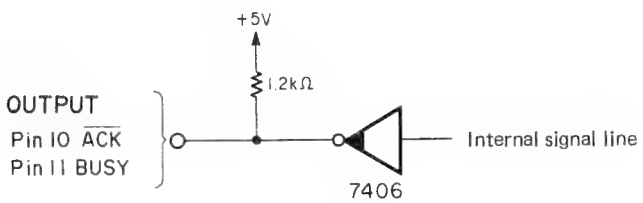


- **Input/output signal lines**

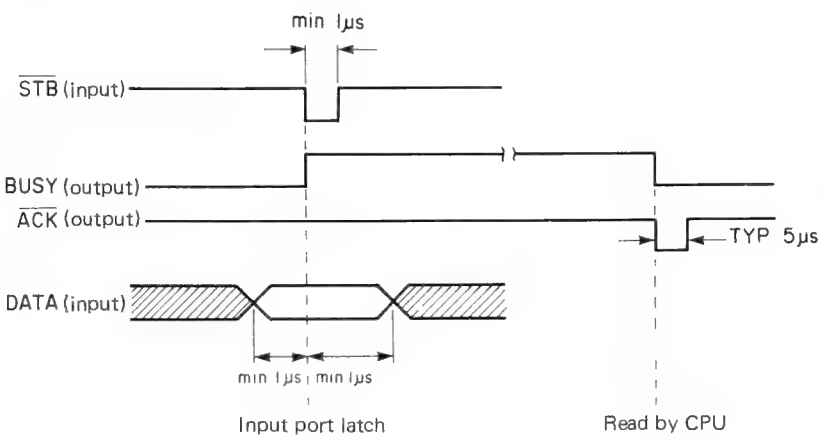
Input/output signals of individual terminals are as follows.







- **Input/output signal timing chart**



b. Serial connection

For serial (RS-232C) connection with various computers, refer to Paragraph 2-7 (page 2-13). For other computers or conditions refer to the following.

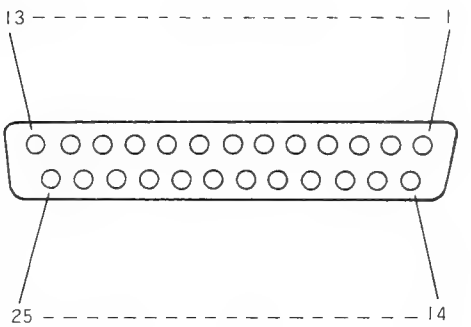
- Connector

Use JAE DB-25PA-XX or equivalent. The plotter is provided with DBLC-25AF or equivalent.

RS-232C connector

Terminal No.	Signal
1	PG
2	TXD
3	RXD
4	RTS
5	CTS
6	DSR
7	SG
8	CD
9	NC
10	NC
11	NC
12	NC
13	NC
14	S. TXD
15	NC
16	S. RXD
17	NC
18	NC
19	NC
20	DTR
21	NC
22	NC
23	NC
24	NC
25	NC

Pin connection



- Signal lines

Pin No.	Abbrev.	Description	I/O
1	PG	Security line which is normally connected with the computer frame. Connected to the plotter frame.	[Com]
2	TXD	Transmit data: Data output from the plotter to the computer. Connected to the receive data line of the computer. SPACE = " 0 " = +12V MARK = " 1 " = −12V	[Output]
3	RXD	Receive data: Data receive line of the plotter from the computer. Connected to the transmit data line of the computer. SPACE = " 0 " = +3V to +25V MARK = " 1 " = −3V to −25V	[Input]
4	RTS	Request to send. Output from the plotter to the computer. When DIP SW-1-5 is set ON (to serial), only ON (+12V) is outputted. With DIP SW-1-5 is set OFF (to parallel), always OFF (−12V) is outputted. *Since it is set when the power switch is turned ON, turning OFF then ON the power switch is necessary for re-setting.	[Output]
5	CTS	Clear to send: Input from the computer to the plotter. When the signal line is ON (+3V to +25V), the plotter is ready to output data, or when the line is OFF (−3V to −25V), no data will be output. When unconnected, the plotter operates with its always ON status.	[Input]
6	DSR	Data set ready: Normally this line is connected with a line to indicate ready-to-operate status of a modem. Input from the computer to the plotter. Same as for CTS when unconnected, with no problem normal operation of the plotter.	[Input]
7	SG	Signal ground, connected with the internal ground line in the plotter.	[Com]
8	CD	Carrier detect, indicating data receive carrier detection. Input from the computer to the plotter. Same as for DSR when unconnected. Note: Select either DSR or CD by DIP SW-2-9 and 10. If computer output is connected when both 9 and 10 are ON, the driver IC of the computer can be damaged. The plotter output is not controlled by ON/OFF of this line.	[Input]
14	S. TXD	Normally, do not connect.	
16	S. RXD	Normally, do not connect.	
20	DTR	Data terminal ready: signal to indicate that the system is ready to communicate. As in RTS, with DIP SW-1-5 set to ON (to serial), The plotter outputs ON (+12V). When hardware handshake is enabled by the ESC @ command and remaining capacity of the buffer is 1/4, DTR is OFF (−12V). When remaining capacity is resumed to 1/2, DTR is ON (+12V). When hardware handshake is set to disable by the ESC @ command, DTR is always +12V. DTR can be connected with CTS, DSR or CD of the computer for handshaking, provided that the computer should have a function to monitor the above signal line and stop the data output.	[Output]

- **Command format**

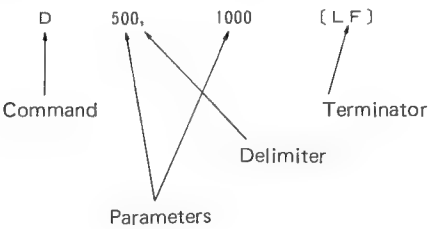
- **Sending a command**

This operation manual describes DXY-880 control using BASIC language. Other languages than BASIC or machine language can also be used for DXY-880.

- **Command format**

DXY-880 command format is composed of Command, Parameter, Parameter .... Parameter, and Terminator. Commands are single or double English capital letters listed in the Commands List.
Parameters provide information for the above commands and are normally input using numbers, however, in some cases, such as for the [P] command, letter codes may be used, and the [H] command has no parameters.
A " , " mark is used to separate the parameters and is known as a "delimiter" and by using this for the [D] command or [I] command, consecutive parameters can be input.
The terminator indicates the end of the drawing command, and normally line feed (LF) or carriage return (CR) is used for the terminator.

Example) DRAW command



Note:

- In DXY-880, delimiter cannot be omitted and a " , " mark or one or more spaces " ␣ " can be used as a delimiter.
- A numeral or symbol other than alphabetical character can be used as a terminator and may be omitted. The terminator cannot be omitted immediately before commands beginning with E.
- A real number within a range of ±16383.0000 (±1.6383E 4) can be used as a coordinate parameter.

- **Variables for parameters**

The following formats can be used.

```
LPRINT "D" ; X; " , "; Y
LPRINT "D" ; X ; "  "; Y
LPRINT "D" ; X ; Y
LPRINT "D" X, Y
```

- **Continuous input of commands**

Two or more commands can be continued.

```
LPRINT " J 3 ; D 1000, 1000 "
LPRINT " J 3 D 1000, 1000"
```

Using the above extended input format, a command of

```
LPRINT "D" ; sin (x), cos (y)
```

will not cause an error. However, for programming interchangeability with former DXY-800, delimiter and terminator are specified in the description of commands.

2. Errors

When a parameter out of the specified range is input, DXY-880 determines that normal operation cannot be performed and displays an error. While some errors allow the plotter to execute subsequent command inputs, normal drawing will not be assured since the command at the time of error occurrence is not executed.

(1) Error identification

When DXY-880 cannot perform its normal operation, the POWER LED will blink to indicate an error. The cause can be one of the following.

- An undefined character is input as a command.
  (F, W, Z etc.)
- Input procedure other than specified.
- Parameter is out of the specified range.
  In such a case, the OE command of RD-GL can be executed to know the error contents. For details refer to the description of the OE command.
  This method can only be used when the plotter is connected with DXY-880 through its serial port (RS-232C).

(2) Error recovery

a) In DXY mode
- Press the HOME key on the control panel.
- Execute the H command.

b) In RD-GL mode
- Press the HOME key on the control panel.
- Execute the OE or IN commands.

If these methods cannot be used, turn OFF the power switch of DXY-880, recheck the program and perform programming again from the start.

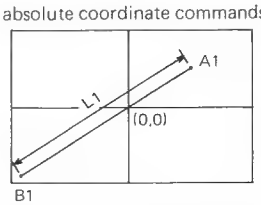
★ The way to avoid Device timeout error on using IBM-PC. Execute below commands after loading DOS.
However, need MODE. COM as System Disk.

In case of Parallel connection . . A > MODE LPT1: , , P
In case of Serial connection . . . A > MODE COMn: baud (, parity (, databits (, stopbits (, P))))

★ The number of characters per a line is fixed by WIDTH message , etc., in BASIC language.
Also, CR.LF are output automatically when the number of characters set in LPRINT message is output.
So then, if too many parameters are input in a line, plotter receives CR.LF midway through the parameter, and disregards parameters after that.
To avoid this, adjust the setting at the computer to increase the number of characters per a line.

★ It becomes an error when the parameter value of each command exceeds following range.

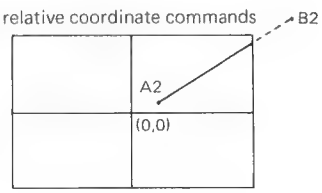
at absolute coordinate commands



The length (L1) from current pen position (A1) to the position designated by parameter (B1) exceeds the following value.

DXY Mode	16383
RDGL Mode	32767

at relative coordinate commands



When specified position (B2) relatively by parameter exceeds a range of world coordinate from the current pen position (A2).

DXY Mode	± 16383
RDGL Mode	± 32767

3. Commands List

DXY Commands

Command		Format	Parameter	Parameter range (default value)	Function	Page
H	Home	H			Coordinate original position	4-3
D	Draw	DX1, Y1 . . . Xn, Yn	Xn: X axis (horizontal) coordinate, Yn: Y axis (vertical) coordinate	−16383 to +16383	Draws a straight line	4-3
M	Move	MX, Y			Moves in a pen up condition	4-4
I	Relative draw	I△X1, △Y1 . . . △Xn, △Yn	△Xn: relative difference in X coordinate, △Yn: relative difference in Y coordinate	−16383 to +16383	Draws a line between relative coordinates	4-4
R	Relative move	R△X, △Y			Same movement as the "I" command in a pen up condition	4-5
L	Line type	Lp	p=0: solid line p=1,2: dotted line p=3,4: single dot-dash line p=5: double dot-dash line	p=0 to 5(0)	Designates a line type	4-5
B	Line scale	Bℓ	ℓ: pitch of dotted line	ℓ=0 to 16383 (80)	Designates the pitch of dotted line	4-7
X	Axis	Xp, q, r	p=0: Y axis p=1: X axis q: scale spacing r: number of repetitions	p=0, 1 q=−16383 to +16383 r=1 to 16383	Draws coordinate axis	4-7
P	Print	Pc1, c2 . . . cn	c1 . . . cn: character string		Prints character	4-8
S	Alpha scale	Sn	n: character size	n=0 to 127 (3)	Designates character size	4-9
Q	Alpha rotate	Qn	n: angle (90° unit)	n=0 to 3 (0)	Designates rotation angle of characters	4-10
N	Mark	Nn		n=1 to 15	Draws marks	4-10
J	Pen change	Jn	n: pen number	n=0 to 8 (1)	Designates pen change	4-11
C	Circle	CX, Y, r, θ_1, θ_2 (, θd)	X, Y: coordinates of center r: radius θ_1: initial angle θ_2: final angle θd: Resolution	X, Y, r= −16383 to +16383 θ_1, θ_2= −32767° to +32767° θd=1° to 179.9999° (5°) $\theta_1 < \theta_2$: CCW $\theta_1 > \theta_2$: CW	Draws circles and arcs	4-11
E	Relative circle	Er, θ_1, θ_2 (, θd)			Draw circles and arcs starting from the current pen position	4-12
A	Circle center	AX, Y			Designates the center coordinates for the G and K commands	4-13
G	A + Circle	Gr, θ_1, θ_2 (, θd)			Draws a circle arc around the position designated by the A command.	4-13
K	A + %	Knℓ1, ℓ2	n: percentage with respect to 0% of the uppermost part ℓ1: distance of the end point from the center ℓ2: distance of the starting point from the center	n=−9101 to +9101% ℓ1 ℓ2= −16383 to +16383	Draws division lines and extraction lines for circles.	4-14
T	Hatching	Tn, X, Y, d, t	n=1: hatching only n=2: boxes only n=3: hatching and boxes X, Y: X axis and Y axis lengths d: spacing between hatching t: hatching angle	n=0 to 3 X, Y, d= −16383 to +16383 t= 1: 0°, 2: 45°, 3: 90°, 4: 135°	Draws hatching or quadrangles	4-16
^	Call RD-GL command	^ [RD-GL command] [parameter] . . . . (, [parameter]) [terminator (;)]			Calls RD-GL command from DXY mode	4-18

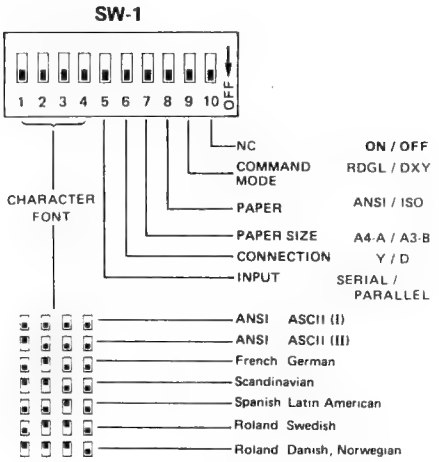
RD-GL Commands

Command		Format	Parameters	Parameter range (default value)	Function	Page
AA	Arc Absolute	AA X, Y, θc (, θd);	X: X coordinate of center Y: Y coordinate of center θc: Center angle θd: Resolution	X,Y: −31200 to +31200 θc: −360° to +360° θd: 1° to 179.9999°(5)	Draws an arc centered at X, Y	5-45
AR	Arc Relative	AR ΔX, ΔY, θc (, θd);	ΔX: Difference of X center coordinates ΔY: Difference of Y center coordinates θc: Center angle θd: Resolution	X,Y: −31200 to +31200 θc: −360° to +360° θd: 1° to 179.9999°(5)	Draws an arc centered at the relative coordinates X, Y	5-46
CA	Alternate Character Set	CA; CAn;	n: character set number	n=0 to 15(0)	Designates the alternate character set	5-28
CI	Circle	CI r (, θd);	r: Radius θd: Resolution	r: −32767 to +32767 θd: 1° to 179.9999°(5)	Draws a circle from the current pen position	5-47
CP	Character Plot	CP; CPnX, nY;	nx: number of characters in X direction ny: number of characters in Y direction	−127 to +127	The pen is moved by the number of characters.	5-25
CS	Standard Character Set	CS; CSn;	n: character set number	n=0 to 15(0)	Designates the standard character set	5-27
DC	Digitize Clear	DC;	None		Digitize end command	5-62
DF	Default	DF;	None		Default	5-6
DI	Absolute Direction	DI; DI run, rise;	run=0 horizontal printing rise= 0 vertical printing	−127 to +127 (run=0, rise=1)	Designates absolute printing direction	5-24
DP	Digitize Point	DP;	None		Digitize command	5-62
DR	Relative Direction	DR; DR run, rise;	run=0 horizontal printing rise=0 vertical printing	−127 to +127 (run=0, rise=1)	Designates relative printing direction	5-22
DT	Define Terminator	DT c;	c: character	Other than null character (CHR$ (3))	Defines the terminator	5-29
EA	Edge Rectangle Absolute	EA X, Y;	X: X coordinate of corner Y: Y coordinate of corner	−32767 to +32767	Draws a rectangle	5-39
ER	Edge Rectangle Relative	ER X, Y;	X: X coordinate of corner Y: Y coordinate of corner	−32767 to +32767	Draws a rectangle with relative coordinates	5-40
EW	Edge Wedge	EW r, θ1, θc (, θd);	r: Radius θ1: Start angle θc: Center angle θd: Resolution	r= −32767 to +32767 θ1=−360° to +360° θc= −360° to +360°	Draws a wedge	5-43
FT	Fill Type	FT n, d, θ;	n= 1, 2: Fill in both directions n=3: Hatching n=4: Cross hatching d: Hatching spacing θ: Hatching angle	n= 1 to 4 d= 0 to 32767 θ= −360° to +360°	Specifies hatching	5-37
IM	Input Mask	IM; IME;			Input mask	5-57
IN	Initialize	IN;	None		Initialization	5-6

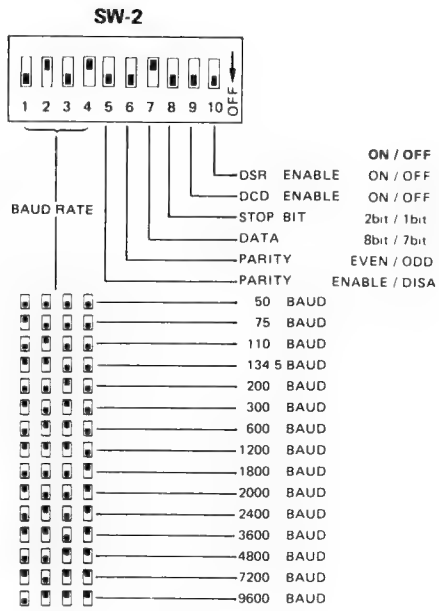
Command		Format	Parameter	Parameter range (default value)	Function	Page
IP	Input P1 & P2	IP P1x,P1y, P2x, P2y;	X and Y coordinates of P1 and P2	Depend on paper size mode of DIP SW setting	Sets P1 and P2	5-50
IW	Input Window	IW X_1, Y_1, X_2, Y_2;	X_1 and Y_1 are coordinates of the left lower corner of the drawing area, X_2 and Y_2 are coordinates of the right upper corner.	Same as above	Sets plotting area	5-53
LB	Label	LB c_1, c_2 . . . on CHR$ (3)	c: character string		Character drawing	5-20
LT	Line Type	LT; LTn, p;	n: pattern No. p: pitch (%)	n=−6 to +6 (0) p=0 to 127 (1.5)	Pitch of dotted or dot-dash-line	5-15
OA	Output Actual Position	OA;	None		Outputs X and Y coordinates of pen position and pen condition (for plotter coordinates only)	5-56
OC	Output Commanded Position	OC;	None		Outputs X and Y coordinates of pen position and pen condition (for user coordinates only)	5-56
OD	Output Digitize	OD;	None		Outputs digitize coordinates	5-62
OE	Output Error	OE;	None		Outputs error code	5-57
OP	Output P1 and P2	OP;	None		Outputs P1 and P2	5-51
OS	Output Status	OS;	None		Outputs status byte	5-58
OW	Output Window	OW;	None		Outputs coordinates of lower left corner and upper right corner of window	5-54
PA	Plot Absolute	PA; PAX_1, Y_1, Xn, Yn;	Absolute X and Y coordinates	−32767 to +32767	Moves in absolute coordinates	5-10
PD	Pen Down	PD; PDX_1, Y_1, Xn, Yn;	X and Y coordinates	−32767 to +32767	Moves in a pen down condition	5-10
PR	Plot Relative	PR; PRX_1, Y_1, Xn, Yn;	Relative X and Y coordinates	−32767 to +32767	Moves in relative coordinates	5-14
PT	Pen Thickness	PT; PT d;	d: Filling spacing (mm)	0.1 to 5 (0.3)	Specifies the filling spacing	5-37
PU	Pen Up	PU; PUX_1, Y_1, Xn, Yn;	X and Y coordinates	−32767 to +32767	Moves in a pen up condition	5-10
RA	Shade Rectangle Absolute	RA X, Y;	X: X coordinate of corner Y: Y coordinate of corner	−32767 to +32767	Fills a rectangle	5-38
RR	Shade Rectangle Relative	RR X, Y;	X: X coordinate of corner Y: Y coordinate of corner	−32767 to +32767	Fills a rectangle using relative coordinates	5-40
SA	Select Alternate Set	SA;			Designates alternate character set	5-29
SC	Scale	SC Xmin, Xmax, Ymin, Ymax;	Xmin, Ymin . . . coordinates of P1 Xmax, Ymax . . . coordinates of P2	Depends on paper size and mode setting of DIP SW.	Sets user coordinates	5-51
SI	Absolute Character Size	SI; SIw, h;	w: character width (cm) h: character height (cm)	(w=0.19 h=0.27)	Designates absolute character size	5-21
SL	Character Slant	SL; SL tan θ	tanθ: character slant	−127 to +127 (0)	Designates character slant	5-21
SM	Symbol Mode	SM; SM k;	k: character or symbol		Draws characters or symbols around the current pen position	5-35

	Command	Format	Parameter	Parameter range (default value)	Function	Page
SP	Pen Select	SP n;	n: pen number	n=0 to 8 (1)	Pen change	5-17
SR	Relative Character Size	SR; SR w, h;	w: character width (%) h: character height (%)	0 to 127 (w=0.5 h=1.0)	Designates relative character size	5-21
SS	Select Standard Set	SS;			Designates stand character set	5-29
TL	Tick Length	TL; TLℓ;	ℓ: tick length (%)	ℓ=−127 to +127 (4)	Sets XT and YT tick	5-34
UC	User Defined Character	UC; UC$\Delta X_1, Y_1$ . . . . Xn, Yn;	Xn: number of X grids Yn: number of Y grids	−99 to +99	Defines user characters	5-30
VS	Velocity Select	VS S;	S: pen speed (cm/sec)	2 to 25 (20)	Sets pen speed	5-17
WG	Shade Wedge	WG r, θ1, θc;	r: Radius θ1:Start angle θc: Center angle	r= −32767 to +32767 θ1= −360° to +360° θc= 0 to 360°	Fills a wedge	5-42
XT	X-tick	XT;	None		Draws tick on X axis	5-34
YT	Y-tick	YT;	None		Draws tick on Y axis	5-34

4. DIP Switch Setting List



SW-1			Paper size	Max. Plotting size
7	8	9		
OFF A3	OFF ISO	OFF DXY	420x297 mm	380x270mm
ON A4	OFF ISO	OFF DXY	297x210mm	270x192mm
OFF B	ON ANSI	OFF DXY	17x11inch	380x258mm
ON A	ON ANSI	OFF DXY	11x8.5inch	258x198mm
OFF A3	OFF ISO	ON RD-GL	420x297mm	380x270mm
ON A4	OFF ISO	ON RD-GL	297x210mm	270x192mm
OFF B	ON ANSI	ON RD-GL	17x11inch	380x258mm
ON A	ON ANSI	ON RD-GL	11x8.5inch	258x198mm



5. Character Code Table

Character set

ASCII

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0				0	③	P	⑨	p		I		−	タ	ミ		π
1			!	1	A	Q	a	q		K	。	ア	チ	ム	α	ρ
2			"	2	B	R	b	r		Λ	「	イ	ツ	メ	β	σ
3	ETX		①	3	C	S	c	s		M	」	ウ	テ	モ	γ	τ
4			$	4	D	T	d	t		N	、	エ	ト	ヤ	δ	υ
5			%	5	E	U	e	u		Ξ	・	オ	ナ	ユ	ε	φ
6			&	6	F	V	f	v		O	ヲ	カ	ニ	ヨ	ζ	χ
7			②	7	G	W	g	w		Π	ァ	キ	ヌ	ラ	η	φ
8	BS		(	8	H	X	h	x	A	P	ィ	ク	ネ	リ	θ	ω
9			)	9	I	Y	i	y	B	Σ	ゥ	ケ	ノ	ル	ι	
A	LF		*	:	J	Z	j	z	Γ	T	ェ	コ	ハ	レ	κ	
B	VT		+	;	K	④	k	Ⓐ	Δ	T	ォ	サ	ヒ	ロ	λ	
C			,	<	L	⑤	l	Ⓑ	E	Φ	ャ	シ	フ	ワ	μ	
D	CR		−	=	M	⑥	m	Ⓒ	Z	X	ュ	ス	ヘ	ン	ν	
E	SO		.	>	N	⑦	n	Ⓓ	H	Ψ	ョ	セ	ホ	゛	ξ	
F	SI		/	?	O	⑧	o	⊢	Θ	Ω	ッ	ソ	マ	゜	ο	

International Character Set

type set	①	②	③	④	⑤	⑥	⑦	⑧	⑨	Ⓐ	Ⓑ	Ⓒ	Ⓓ
(0):ANSI ASCII (I)	#	'	@	[	\	]	^	_	`	{	¦	}	~
(1):ANSI ASCII (II)	#	'	@	[	√	]	↑	¯	`	π	⊢	→	~
(2):French/German	£	'	@	[	ç	]	^	¯	`	¨	°	¨	'
(3):Scandinavian	£	'	@	Ø	Æ	ø	æ	¯	`	¨	°	¨	°
(4):Spanish/Latin	¿	'	@	[	¡	]	^	¯	`	~	°	~	~
(6):Swedish	#	'	É	Ä	Ö	Å	Ü	_	é	ä	ö	å	ü
(7):Danish/Norwegian	#	'	@	Æ	Ø	Å	Ü	_	'	æ	ø	å	ü

(13):Japanese	ASCII codes 20 (H) to 5F (H) are set to characters of A0 (H) to DF (H).
(15):Mark	ASCII codes 41 (H) to 4F (H) (A to O) are set to the following marks.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
◫	ⓘ	⚠	+	×	◈	✦	⊠	⊿	Y	⌘	✳	⧖	I	✡

6. Sample programs

DXY-880 can be used for various applications depending on programs. Sample programs are shown here for the following applications. These programs will be applied for practical purposes by changing the data and parameters accordingly, or give you a hint for programming.

1. Bar chart
2. Radar chart
3. Biorhythm
4. Label
5. Fourier curve
6. General purpose calendar

Use of sample programs

- These sample programs have been prepared using common BASIC commands and statements, however, depending on your computer type, they may not be used as they are. In such a case, read the BASIC Manual of your computer and modify the programs accordingly.
  In case that LPRINT statement cannot be used depending on the connection type with your computer, use PRINT # statement, for example, as described in the BASIC Manual.

- In the programs, data character strings and numerals are defined using DATA statement. Numerals and character strings for variables are also defined at the beginning of programs. Thus, the programs can be used as they are for actual applications by using INPUT statement or by changing only the data. List of variables and DATA statement of each program are listed only for the parts requiring modification, and other parts require almost no modification.

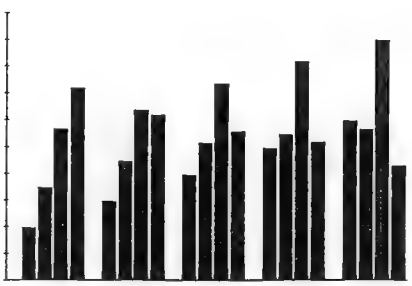
- Variable name also may not match your computer type. Modify accordingly if any.

Bar chart

Bar chart can be recommended to look over sales trend of four commodities for five months.

- Variable list
  X, Y : Coordinates of the lower left corner of the chart (start position of the chart)
  YL : Scale line spacing of Y axis (in 0.1 mm unit)
  YM : Data size for the unit scale of Y axis
  X1 : Commodity type
  X2 : Number of months
  XK : Bar width (in 0.1 mm unit)
  STP : Shading space (0.1 mm unit)
  P (1) – (X1) : Pen number used, must be same as commodity type, X1.

- DATA statement
  Lines 160 to 190 contain data for individual commodities for five months.



- Program list

```
100 ' Bar chart
110 LPRINT "J1"
120 X= 100:Y= 100:YL=100:YM=10:X1=4:X2=5:XK=60:STP=2
130 P(1)=2:P(2)=4:P(3)=5:P(4)=8
140 ' DATA X1*X2 [KO]
150 FOR I=1 TO X1:FOR J=1 TO X2:READ Y(I,J):NEXT J,I
160 DATA 20,30,40,50,60
170 DATA 35,45,52,55,57
180 DATA 57,64,74,82,90
190 DATA 72,62,56,52,43
200 ' MAX
210 MAX=0
220 FOR I=1 TO X1:FOR J=1 TO X2
230   IF MAX<Y(I,J) THEN MAX=Y(I,J)
240 NEXT J,I
250 ' FRAME
260 LPRINT "M";X;",";Y:LPRINT "X0,";YL;",";INT(MAX/YM+1)
270 LPRINT "M";X;",";Y:LPRINT "D";X+(X1+1)*X2*XK;",";Y
280 ' CHART
290 FF=1
300 FOR I=1 TO X1:LPRINT "J";P(I)
310   FOR J=1 TO X2:YY=Y(I,J)/YM*YL:XX=X+I*XK+(X1+1)*(J-1)*XK
320     LPRINT "M";XX;","Y+5
330     LPRINT "T2,";XK-8;",";YY-5;",0,1"
340     FOR K=STP TO XK-8-STP STEP STP
350       Y1=Y+5+STP:Y2=Y+YY-STP:XXX=XX+K
360       FF=-FF:IF FF=1 THEN SWAP Y1,Y2
370       LPRINT "D";XXX;Y1;",";XXX",";Y2
380     NEXT K
390   NEXT J
400 NEXT I
410 LPRINT "J0":END
```

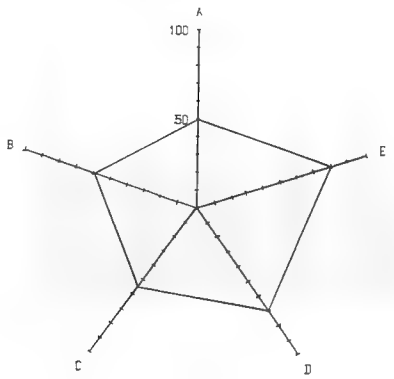
Radar chart

Used to systematically evaluate different data, ranging from stock price analysis to determination of character.

- Variable list
  ELEMENTS: Number of elements, for example, 5 designates a pentagon and 6 designates a hexagon.
  XX, YY : Coordinates of the radar chart center
  LENGTH : Length of an axis (in 0.1 mm unit)
  DISTANCE : Scale lines

- DATA statements
  Line 1060: Character string for data
  Line 1070: Value of data; place the same value as the first data after the DATA statements.

- Subroutines
  POSITION: Calculates coordinates of the end points of axis.
  SCALE : Draws scale lines
  LABEL : Calculates coordinates of characters showing the contents of data.



- Program list

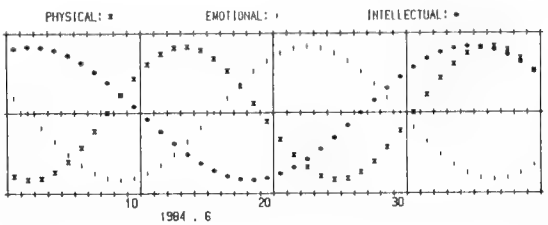
```
1000 ' Radar chart
1010 ' Set a black pen to J2 red pen to J3
1020 ELEMENTS=5
1030 DATA A,B,C,D,E
1040 DATA 50,60,55,70,80,50
1050 XX1=1000 :YY1=1000
1060 LENGTH=500
1070 PI=3.14159
1080 ANGLE=2*PI/ELEMENTS
1090 DISTANCE=LENGTH/10
1100 ' Drawing axis
1110 LPRINT "^DI1,0;"
1120 LPRINT "J2"
1130 FOR A=PI/2 TO 4.99*PI/2 STEP ANGLE
1140   LPRINT "^SI 0.4,0.25;"
1150   LPRINT "^PA";XX1;",";YY1
1160   LPRINT "^DI";SIN(A);",";-COS(A);";"
1170   LPRINT "^SM-"
1180   LPRINT "^PD"
1190   FOR I=DISTANCE TO DISTANCE*10 STEP DISTANCE
1200     GOSUB 1410
1210     LPRINT "^PA";X1;",";Y1
1220   NEXT I
1230   LPRINT "^PU"
1240   LPRINT "^SM"
1250   IF A=PI/2 THEN GOSUB 1450
1260   GOSUB 1530
1270 NEXT A
1280 ' Numerical value
1290 LPRINT "J3"
1300 FOR A=PI/2 TO 5.01*PI/2 STEP ANGLE
1310   READ VALUE
1320   I=VALUE*DISTANCE/10
1330   GOSUB 1410
1340   IF A=PI/2 THEN LPRINT "M";X1;",";Y1
1350   LPRINT "D";X1;",";Y1
1360 NEXT A
1370 LPRINT "S3"
1380 LPRINT "H"
1390 END
1400 ' Subroutine
1410 'POSITION
1420   X1=XX1+INT(COS(A)*I)
1430   Y1=YY1+INT(SIN(A)*I)
1440 RETURN
1450 'SCALE
1460   LPRINT "^DI1,0;"
1470   LPRINT "S2"
1480   LPRINT "M";XX1-60;",";YY1+DISTANCE*4.7
1490   LPRINT "P50"
1500   LPRINT "M";XX1-80;",";YY1+DISTANCE*9.7
1510   LPRINT "P100"
1520 RETURN
1530 'LABEL
1540   LPRINT "^DI1,0;"
1550   READ L$
1560   LPRINT "^SM";L$
1570   LPRINT "^SI0.32,0.56;"
1580   I=DISTANCE*11
1590   GOSUB 1410
1600   LPRINT "^PA";X1;",";Y1
1610   LPRINT "^SM"
1620 RETURN
```

Biorhythm

By entering date of birth and month to be checked for biorhythm, draws a biorhythm curve for 40 days starting with the first day of the month.

- Variable list

BY	: Year of birth (AD)
BM	: Month of birth
BD	: Day of birth
SY	: Year to be checked for biorhythm
SM	: Month to be checked for biorhythm
SD	: Enter 1
OX, OY	: Coordinates of start position of drawing the frame



- Program list

```
1000 '  BIORHYTHM
1010 '
1020 '  DATA
1030 BY=1960:BM=1:BD=1
1040 SY=1984:SM=6:SD=1
1050 OX=300:OY=300
1060 PI=3.1415:P=1
1070 DIM M(12)
1080 FOR I=1 TO 12
1090      READ M(I)
1100 NEXT
1110 DATA 0,31,59,90,120,151,181,212,243,273,304,334
1120 '  CALCULATION
1130 L=(SY-BY)*365+INT((SY-1)/4)-INT((BY+1)/4)+(M(SM)+SD)-(M(BM)+BD)
1140 '  FRAME
1150 FOR X=300 TO 2300 STEP 500
1160      LPRINT "M";X,OY
1170      LPRINT "X0,300,2"
1180 NEXT
1190 FOR Y=300 TO 900 STEP 300
1200      LPRINT "M";OX,Y
1210      LPRINT "X1,50,40"
1220 NEXT
1230 '  PLOT
1240 T=23:LABEL$="PHYSICAL: ":GOSUB 1280
1250 T=28:LABEL$="EMOTIONAL: ":GOSUB 1280
1260 T=33:LABEL$="INTELLECTUAL: ":GOSUB 1280
1270 GOTO 1420
1280 'PLOT
1290 A=(L/T-INT(L/T))*T
1300 P=P+1
1310 LPRINT "J";P
1320 FOR DAY=1 TO 40
1330      Y=INT(250*SIN((A+DAY)/T*2*PI)+.5)
1340      LPRINT "M";DAY*50+275,Y+600
1350      LPRINT "N";P+11
1360 NEXT
1370 LPRINT "M";P*600-750,OY+650
1380 LPRINT "P";LABEL$
1390 LPRINT "R0,15"
1400 LPRINT "N";P+11
1410 RETURN
1420 '  LABEL
1430 LPRINT "J1"
1440 FOR I=10 TO 30 STEP 10
1450      LPRINT "M";I*50+220,OY-50
1460      LPRINT "P";I
1470 NEXT
1480 LPRINT "M850,200"
1490 LPRINT "P";SY;".";SM
1500 LPRINT "J0"
1510 LPRINT "H"
1520 END
```

Label

Makes right flush, left flush or centering of characters and uses for printing title lines.

- Variable list

  L$ ( ) : Character string to be drawn; put a number into ( ) according to the number of character strings to be drawn. Three character strings (0 to 2) are used in this program and 2 is put into ( ).

  OX, OY : Coordinates of the start position for left flush, of the center position for centering, or of the end point for right flush.

  SI : Designates the character size with the same unit as for the parameter in the S command in DXY mode.

- DATA statement

  Line 1080 : Character strings in number specified in L$.

- Program list

```
1000 '  LABEL ORIGIN
1010 '
1020 '  DATA
1030 DIM L$(2),LL(2)
1040 FOR I=0 TO 2
1050   READ L$(I)
1060   LL(I)=LEN(L$(I))
1070 NEXT I
1080 DATA ROLAND DG CORPORATION,X-Y PLOTTER,DXY-880
1090 SI=3
1100 LPRINT "S";SI
1110 '  LEFT
1120 LO=1
1130 OX=500:OY=1500
1140 GOSUB 1340
1150 '  CENTER
1160 LO=2
1170 OX=1500:OY=2000
1180 GOSUB 1340
1190 '  RIGHT
1200 LO=3
1210 OX=2500:OY=1500
1220 GOSUB 1340
1230 '  LARGE
1240 LO=2
1250 SI=6
1260 LPRINT "S";SI
1270 OX=1500:OY=1000
1280 FOR S=0 TO 3
1290   OX=OX+S
1300   OY=OY-S
```

```
1310   GOSUB 1340
1320 NEXT
1330 END
1340 'PLOT
1350 FOR I=0 TO 2
1360   X=OX
1370   IF LO=2 THEN X=X-(LL(I)*6*(SI+1))/2
1380   IF LO=3 THEN X=X-(LL(I)*6*(SI+1))
1390   Y=OY-I*7*(SI+1)*2
1400   LPRINT "J";LO
1410   LPRINT "M";X,Y
1420   LPRINT "P";L$(I)
1430 NEXT
1440 RETURN
```

Fourier curve

Connects data points with a smooth curve to prepare a graph. Fourier transform is used to make a smooth curve. When n data, X_0, X_1 . . . . . X_{n-1}, are given, coefficients ak and bk of finite Fourier expansion are given by the following formulas.

$$a_k = \frac{2}{N}\sum_{j=0}^{N-1} X_j \cos\left(2\pi jk/N\right)$$

$$b_k = \frac{2}{N}\sum_{j=0}^{N-1} X_j \sin\left(2\pi jk/N\right)$$

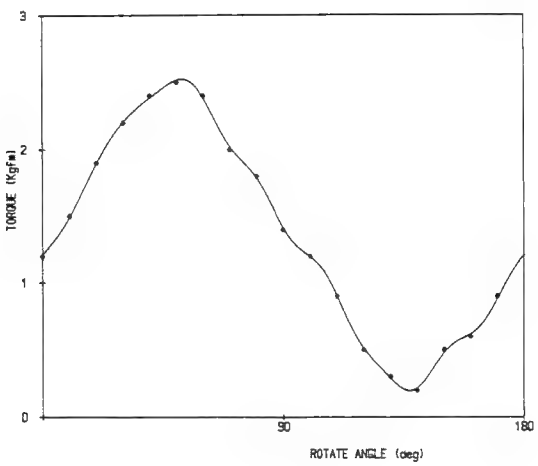
$$\left(k = 0, 1, 2, \cdots\cdots, \frac{N}{2}-1\right)$$

The Fourier expansion formula is:

$$f(x) = \frac{a_0}{2} + a_1\cos X + b_1 \sin X + a_2 \cos 2X + b_2 \sin 2X \cdots\cdots\cdots\cdots + a_{n-2}\cos(n-2)X + b_{n-2}\sin(n-2)X + \frac{1}{2}\left(a_{n-1}\cos(n-1)X + b_{n-1}\sin(n-1)X\right)$$

In this program, calculation of coefficients ak and bk is made in the part of ' CALCULATION and Fourier expansion in ' TORQUE.

- Variable list
  OX, OY : Coordinates of point of origin of the graph
  N : Number of data



- Program list

```
1000 '  FOURIER
1010 '
1020 OX=500:OY=500
1030 PI=3.1415:N=18
1040 DIM A(17),B(17),X(17)
1050 '  FRAME
1060 LPRINT "M";OX,OY
1070 LPRINT "X1,900,2"
1080 LPRINT "D";OX+1800,OY+1500
1090 LPRINT "D";OX,OY+1500
1100 LPRINT "X0,-500,3"
1110 LPRINT "M";OX+880,OY-50
1120 LPRINT "P90";SPC(47);"180"
1130 LPRINT "M";OX+1000,OY-150
1140 LPRINT "PROTATE ANGLE (deg)"
1150 FOR I=0 TO 3
1160   LPRINT "M";OX-100,OY+500*I-15
1170   LPRINT "P";I
1180 NEXT
1190 LPRINT "Q1"
1200 LPRINT "M";OX-100,OY+700
1210 LPRINT "PTORQUE (Kgfm)"
1220 '  DATA
1230 FOR I=0 TO 17
1240   READ X(I)
1250   LPRINT "J2"
1260 LPRINT "M";OX+I*100,OY+X(I)*500
1270 LPRINT "N15"
1280 NEXT
1290 '  CALCULATION
1300 FOR I=0 TO N/2-1
1310   A(I)=0
1320   B(I)=0
1330   FOR J=0 TO N-1
1340     A(I)=A(I)+X(J)*COS(2*PI*J*I/N)
1350     B(I)=B(I)+X(J)*SIN(2*PI*J*I/N)
1360  'NEXT J
1370   A(I)=2*A(I)/N
1380   B(I)=2*B(I)/N
1390 NEXT I
1400 A(0)=A(0)/2
1410 '  PLOT
1420 LPRINT "M";OX,OY+X(0)*500
1430 FOR AN=0 TO 180
1440   GOSUB 1480
1450   LPRINT "D";OX+AN*10,OY+TR*500
1460 NEXT AN
1470 END
1480 'TORQUE
1490 TR=A(0)
1500 FOR J=1 TO N/2-1
1510   TR=TR+A(J)*COS(2*PI*J*AN/180)+B(J)*SIN(2*PI*J*AN/180)
1520 NEXT J
1530 TR=TR-A(N/2-1)*COS(2*PI*(N/2-1)*AN/180)/2-B(N/2-1)*SIN(2*PI*(N/2-1)*AN/180)
/2
1540 RETURN
1550 DATA 1.2,1.5,1.9,2.2,2.4,2.5,2.4,2.0,1.8,1.4,1.2,0.9,0.5,0.3,0.2,0.5,0.6,0.
9
```

Calendar

A convenient program to prepare a calendar for a month. By entering year and month, days of the week are automatically calculated.

- Variable list
  - SY : Year (AD) of the calendar to be prepared.
  - SM : Month of the calendar
  - XX1, YY1 } Start position of drawing when days are placed in a horizontal line and days of the week in the next line.
  - DX1 : Enter the print spacing in X direction of dates and days of the week in unit of 0.1 mm.
  - XX2, YY2 } Start position of drawing when days are placed in a vertical line and days of the week in the next line.
  - DX2 : Enter the print spacing in Y direction of dates and days of the week in unit of 0.1 mm.
  - XX3, YY3 } Start position of drawing in a week per line as in ordinary calendars.
  - DX3, DY3 } Designates spacing between dates in unit of 0.1 mm for X axis and Y axis respectively.
  - DISTX, DISTY } Designates spacing between dates and between days of the week in unit of 0.1 mm for X axis and Y axis respectively.

Practically, there will be little case to prepare these three types at a time. Then, put REM or ' (an abbreviated form of REM statement, some computer types may not use this form) before an unnecessary calendar type (VERTICAL, HORIZONTAL, NORMAL) of GOSUB statements of line 1330 to 1350.

```
FRI SAT SUN MON TUE WED THU FRI SAT SUN MON TUE WED THU FRI SAT SUN MON TUE WED THU FRI SAT SUN MON TUE WED THU FRI SAT
  1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30
```

```
FRI  1
SAT  2
SUN  3
MON  4
TUE  5
WED  6
THU  7
FRI  8
SAT  9
SUN  10
MON  11
TUE  12
WED  13
THU  14
FRI  15
SAT  16
SUN  17
MON  18
TUE  19
WED  20
THU  21
FRI  22
SAT  23
SUN  24
MON  25
TUE  26
WED  27
THU  28
FRI  29
SAT  30
```

```
SUN MON TUE WED THU FRI SAT
                    1   2
  3   4   5   6   7   8   9
 10  11  12  13  14  15  16
 17  18  19  20  21  22  23
 24  25  26  27  28  29  30
```

- Program list

```
1000 ' Calender
1010 ' Put a black pen into J2, a red pen into J3 and a blue pen into J4
1020 DIM M(12)
1030 DIM DW$(7)
1040 INPUT "What year";SY
1050 INPUT "What month";SM
1060 XX1=350 :YY1=2450 :DX1=70
1070 XX2=250 :YY2=2400 :DY2=50
1080 XX3=1000 :YY3=1850 :DX3=85 :DY3=50
1090 ' Days of the week
1100 FOR I=0 TO 6
1110   READ DW$(I)
1120 NEXT I
1130 DATA SUN,MON,TUE,WED,THU,FRI,SAT
1140 FOR I=1 TO 12
1150   READ M(I)
1160 NEXT I
1170   IF SY/4=INT(SY/4) THEN M(2)=M(2)+1
1180   IF SY/100=INT(SY/100) THEN M(2)=M(2)-1
1190   IF SY/400=INT(SY/400) THEN M(2)=M(2)+1
1200 DATA 31,28,31,30,31,30,31,31,30,31,30,31
1210 MSUM=0
1220 FOR J=1 TO SM-1
1230   MSUM=MSUM+M(J)
1240 NEXT J
1250 L=SY*365+INT((SY-1)/4)+MSUM-1
1260 IF SY/100=INT(SY/100) THEN L=L-1
1270 K=L-INT(L/7)*7
1280 ' Mainroutine
1290 FOR DAY=1 TO M(SM)
1300   N=((DAY+K-1)/7-INT((DAY+K-1)/7))*7
1310   Y$=DW$(N)
1320   LPRINT "J2"
1330   IF Y$="SUN" THEN LPRINT "J3"
1340   IF Y$="SAT" THEN LPRINT "J4"
1350   GOSUB 1420
1360   GOSUB 1490
1370   GOSUB 1560
1380 NEXT DAY
1390 LPRINT "H"
1400 END
1410 ' Subroutine
1420 '*Horizontal
1430   X=XX1+DX1*DAY
1440   Y=YY1
1450   GOSUB 1650
1460   DISTX=-22 :DISTY=50
1470   GOSUB 1720
1480 RETURN
1490 '*Vertical
1500   X=XX2
1510   Y=YY2-DY2*DAY
1520   GOSUB 1650
1530   DISTX=70 :DISTY=0
1540   GOSUB 1720
1550 RETURN
1560 '*Normal
1570   X=XX3+DX3*N
1580   Y=YY3-DY3*INT((DAY+K-1)/7)
1590   GOSUB 1650
1600   DISTX=-22 :DISTY=50
1610   IF DAY>7 THEN GOTO 1640
1620   IF INT((DAY+K-1)/7)=1 THEN Y=Y+DY3
1630   GOSUB 1720
1640 RETURN
1650 '*SUB1
1660   LPRINT "S3"
1670   A=0
1680   IF DAY<10 THEN A=22
1690   LPRINT "M";X+A;",";Y
1700   LPRINT "P";DAY
1710 RETURN
1720 '*SUB2
1730   LPRINT "S2"
1740   LPRINT "M";X-DISTX;",";Y+DISTY
1750   LPRINT "P";Y$
1760 RETURN
```

7. Specifications

Plotting area	X axis: 380 mm, Y axis: 270 mm (ISO A3 size)
Plotting speed	200 mm/sec for all directions
Resolution	0.05 mm/step
Distance accuracy	± 0.5% or less of traveling distance
Repeatability	± 0.3 mm or less
Control switches	PEN UP/DOWN, PAUSE, HOME POSITION (∧ , < , ∨ , >), FAST, P1, P2, ENTER, POWER
DIP switches	FONT, MODE, BAUD RATE, MODE
Display LEDs	POWER/ERROR, PEN UP
Interfaces	Parallel (Centronics) Serial (RS-232C)
Number of pens	8 (original pens or pen holder)
Power supply	Original AC adapter (for 9VDC, 28VDC)
Power consumption	35W
Dimensions	533 x 430 x 90 mm (21"(W) x16-15/16"(D)x 3-1/2"(H))
Weight	4.3 kg (9.5 lbs) (main unit only)
Operating temperature	0°C to 40°C
Operating humidity	20 to 80% (no dew forming)
Input/output signals	
Parallel	Centronics STROBE (1 bit), DATA (8 bits) BUSY (1 bit), ACK (1 bit) TTL level, asynchronous
Serial	RS-232C Transfer system: asynchronous, half-duplex data communication Baud rate : 50, 70, 110, 134.5, 200, 300, 600 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600 (selected by DIP switch) Stop bit: 1 or 2 bits (selected by DIP switch) Parity check: Odd, even, none (selected by DIP switch) Data bits: 7 or 8 bits (selected by DIP switch) Connector: DB – 25S

* Specifications are subject to change without notice.

DXY-880 '84. NOV. AE-2

Roland DG

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